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IN THE

Supreme Court of the United States

OCTOBER TERM, 1983

BURROUGHS CORPORATION,

Petitioner,

vs.

A. B. DICK COMPANY,

Respondent.

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

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Questions Presented

1. Whether a patent owner, having had a full and fair opportunity to litigate the scope of his patent, and having obtained a trial and final resolution of that issue, should be entitled to relitigate the same issue in subsequent litigation;

2. Whether our overcrowded courts can long endure, and the industrial community can plot its course, under a rule of law that permits the scope of a patent, once litigated and determined by a final judgment, to be relitigated again and again; and

3. Whether a "case or controversy" under Article III of the Constitution is presented by a dispute over the scope of a patent, irrespective of the presence of the issues of validity and infringement.

Parties Below

The plaintiff in this case is A. B. Dick Company, a Delaware corporation. The defendant is Burroughs Corporation, a Michigan corporation.

Pursuant to Rule 28.1 of this Court, Petitioner Burroughs Corporation states that it has no parent companies, and that it has the following subsidiaries and affiliates (other than wholly owned subsidiaries): Tata Burroughs Ltd. (India); Memorex Japan Ltd.; Societe de Location et d'Entretien Machines Electroniques (France); Disk Media Inc. (Cal.); Memorex DIC Corp. (Cal.); Peripheral Components Inc. (Del.); Japan Softec Co. Ltd. (Japan); Teijin Memorex Company Ltd. (Japan); and SDC (1981) Limited (U.K.).

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BURROUGHS CORPORATION,

Petitioner,

VS.

A. B. DICK COMPANY,

Respondent.

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

Petitioner, Burroughs Corporation, respectfully requests that a writ of certiorari issue to review the judgment entered in this case on July 27, 1983 by the United States Court of Appeals for the Federal Circuit.

Opinions of the Courts Below

The opinion of the Court of Appeals for the Federal Circuit is reported at 713 F.2d 700 (A 105). The opinion of the District Court for the Northern District of Illinois, Eastern Division, is reported at 550 F.Supp. 1065 (A 87).

The opinion of the District Court for the Southern District of Ohio, in the related case of *Mead Digital Systems, Inc.* v. *A. B. Dick Co.*, is reported at 521 F.Supp. 164 (A 1). The final judgment entered by the *Mead* court (A 82), and the accompanying letter of Judge Rice (A 79), are unreported.

Jurisdiction

The judgment of the Court of Appeals for the Federal Circuit was entered on July 27, 1983. This petition is being filed within ninety days of the entry of judgment. The jurisdiction of this Court arises under 28 U.S.C. 1254 (1).

Constitutional Provision Involved

This case involves the following "case or controversy" provision of Article III, § 2, cl. 1 of the United States Constitution:

> The judicial Power shall extend to all Cases, in Law and Equity, arising under . . . the Laws of the United States . . .;—to Controversies . . . between Citizens of different States. . . .

Statement of the Case

This is a patent infringement suit. The A. B. Dick Company sued Burroughs Corporation in the Northern District of Illinois, Eastern Division, claiming that ink-jet character printers manufactured by Burroughs infringe U.S. patent 3,596,275, issued to Richard G. Sweet, and a Lewis-Brown patent (not presently in issue). District Court jurisdiction was based on 28 U.S.C. 1338 (a), 2201 and 2202.

The Sweet patent relates to an oscillographic recorder which can directly record ink drops on paper to produce a replica of the waveform of a continuously varying electrical signal.

The Sweet patent is being asserted by A. B. Dick to cover commercial ink-jet character printers.

In a prior suit against the Mead Corporation, after a full trial on the merits, the Sweet patent was adjudged, in a declaration appearing in a final judgment, to be limited in scope to oscillographic recording (A 82). This

construction was based upon both the relevant prior art and a file wrapper estoppel (A 12-15, 33, 59).

In the present suit, the District Court granted defendant's motion for summary judgment, finding that the *Mead* court's ruling on the Sweet patent's scope is entitled to collateral estoppel effect, and that the undisputed facts show that the accused Burroughs equipment does not fall within that scope.

The Court of Appeals held that no collateral estoppel can apply to a ruling on a patent's scope unless that ruling is essential to a ruling on validity or infringement, and it cannot apply to products not before the first court. It therefore reversed (A 117-18).

A. B. Dick-Mead Litigation

Shortly after the present suit was instituted, A. B. Dick sued the Mead Corporation for patent infringement in the same court, claiming that Mead's ink-jet character printers infringe both the Sweet patent and the Lewis-Brown patent. Mead's subsidiary, in turn, filed a declaratory judgment action in the Southern District of Ohio, demanding a declaration as to the validity, scope and infringement of the two patents. The *Mead* actions were thereafter consolidated and tried in Ohio (A 11-12).

The *Mead* case went to trial on both the patent infringement and declaratory judgment actions, after the entry of a final pretrial order that included the following issues to be tried:

> "10.. What is the legal scope of the claims of the Sweet patent?
>
> • • • • • •
>
> "12. Does the legal scope of the claims of the Sweet patent define patentable subject matter in view of prior art?

"13. Has the legal scope of the claims of the Sweet patent been infringed by any product of Mead?" (A 68-9)

After an extensive trial and briefing, the District Court, sitting without a jury, considered the prior art references, as well as the file history of the Sweet application before the Patent Office, and considerable other evidence, and held the Sweet patent to be limited in scope, and not infringed, but valid as so construed (A 79, 82).[1]

The final judgment of the District Court, in the *Mead* suit, included the following specific declaration as to the scope of the Sweet patent:

"2. The Sweet patent is limited in scope to oscillographic recording." (A 83)

A. B. Dick challenged the inclusion of this holding on scope in the final judgment, asserting that it was in the nature of an advisory opinion, not based on a case or controversy, and, consequently, beyond the court's power under the Constitution (A 73). That argument was rejected.

The District Court judgment was appealed by A. B. Dick to the Court of Appeals for the Sixth Circuit, and that appeal is still pending.

A. B. Dick-Burroughs Litigation

Following the filing of the *Mead* opinion, Burroughs amended its Answer to plead collateral estoppel, and, once the *Mead* final judgment was entered, Burroughs moved for summary judgment on the grounds that:

(1) the scope of the Sweet patent had been determined in a final judgment in the *Mead* case, which is entitled to collateral estoppel effect, and

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[1] The *Mead* court also held Lewis-Brown patent 3,298,030 to be invalid, and, as already noted, that patent is not at issue here.

(2) the accused Burroughs equipment clearly falls outside the adjudicated scope.

The District Court granted summary judgment (A 87), but the Court of Appeals for the Federal Circuit reversed, holding that:

> "Except in the context of validity or infringement, judicial statements regarding the scope of patent claims are hypothetical insofar as they purport to resolve the question of whether prior art or products not before the court would, respectively, anticipate or infringe the patent claims. . . .
>
> • • • • • •
>
> "In view of the foregoing, we hold that judicial statements regarding the scope of patent claims are entitled to collateral estoppel effect in a subsequent infringement suit only to the extent that determination of scope was essential to a final judgment on the question of validity or infringement; further that such statements should be narrowly construed." (A 117-18)

Reasons for Granting the Writ

POINT I

The CAFC ruling, in this case, on the basically important question of the scope of a patent, is directly contrary to this Court's collateral estoppel rulings over the past decade.[2]

This Court's *Blonder-Tongue* ruling in 1971 rejected the then-maligned doctrine of mutuality of estoppel, which had protected a patent owner's right to sue alleged infringers successively, even though the patent were held

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[2] See, e.g., *Blonder-Tongue* v. *University Foundation*, 402 U.S. 313 (1971); *Parklane Hosiery Co.* v. *Shore*, 439 U.S. 322 (1979); *Montana* v. *United States*, 440 U.S. 147 (1979); *Allen* v. *McCurry*, 449 U.S. 90 (1980).

invalid in the first suit. *Triplett* v. *Lowell*, 297 U.S. 638 (1936).

Parklane Hosiery thereafter made it clear that while *Blonder-Tongue* found needless relitigation particularly wasteful, and baseless, where a patent has been held to be invalid, the Court in *Blonder-Tongue* had actually addressed the broader question of "whether it is any longer tenable to afford a litigant more than one full and fair opportunity for judicial resolution of the same issue." 439 U.S. at 327-8; see, also, *Allen* v. *McCurry*, 449 U.S. at 94-5.

This principle was extended to the offensive use of collateral estoppel in *Parklane*, and it has been recognized as applicable to every sphere of civil litigation. See, e.g., *Montana* v. *United States*, *supra*; *Allen* v. *McCurry*, *supra*.

In the present case, the CAFC has completely undermined the principle of these cases as it applies to a vital area of patents, their scope, which has long been a subject of concern to this Court. See, especially, *Blonder-Tongue*, 402 U.S. at 343-4, 349-50; and the cases *infra*, on page 13.

Moreover, since the CAFC has nationwide impact in all cases pertaining to patents, it will be the CAFC ruling, and not the rulings of this Court, that will compel adherence by the district courts, until this matter has been rectified. 28 U.S.C. 1292 (c) and (d), 1295; *South Corp.* v. *United States*, 690 F.2d 1368, 1371 (Fed. Cir. 1982); *Radio Steel & Mfg. Co.* v. *MTD Products Inc.*, 566 F.Supp. 609, 613 (N.D. Ohio 1983); *Union Carbide Corp.* v. *American Can Co.*, 558 F.Supp. 1154, 1156 (N.D. Ill. 1983).

Both the District Court and the CAFC recognized that collateral estoppel can apply only to an issue that has been actually and necessarily determined in a prior suit, under circumstances that afforded a full and fair opportunity to litigate the issue. (A 93, 112); *Montana*, 440 U.S. at 153.

On the question of a full and fair opportunity to litigate, as the District Court observed, this has not been raised by A. B. Dick (A 94). Nor can there be any question that the issue of scope was actually litigated in the *Mead* case (Id).

The only question in serious dispute is the essential nature of the scope holding in *Mead*. The District Court found it essential (A 96); the CAFC did not (A 118).

More specifically, the CAFC found that the *Mead* court's determination of scope was not essential to its final judgment on validity or infringement (A 117-18). While the construction of the Sweet patent was the predicate for the *Mead* court's holding that the Sweet patent is invalid "as so construed" (A 80), the error of the CAFC is more fundamental.

The CAFC erroneously ruled that a court's final judgment of the scope of a patent, even in the course of a protracted multi-million dollar litigation concerning the patent, can be deemed an essential issue for collateral estoppel purposes only when it underlies, and only to the extent that it underlies, the issue of validity or infringement. It held that a final judgment on scope cannot affect any product not actually before the court, and, as a consequence, each new product must project a new suit. There is no rational basis for such a rule of law.

The facts here are that Mead is in the ink-jet printing business. It was charged with infringement, and then sued. It filed a declaratory judgment action in which it sought to have the scope of the Sweet patent determined, it projected scope as an issue in the final pretrial order, litigated this issue, and argued successfully against A. B. Dick's assertion that the court did not have the jurisdiction to determine the issue (A 65).

The result, after a full and fair litigation of the issue, was a declaration of the patent's scope in the *Mead* final judgment.

Thus, the ruling on scope was not merely a finding incidental to a judgment on another issue, or necessary merely to clarify language in some of the claims for infringement purposes. It was itself a judgment, as a declaration contained in the final judgment in a declaratory judgment action, and the findings to the same effect, that were embodied in the court's opinion, were necessary to that judgment.[8]

This Court has said that "once an issue is actually and necessarily determined by a court of competent jurisdiction, that determination is conclusive in subsequent suits based on a different cause of action involving a party to the prior litigation. Application of [this] . . . doctrine is central to the purpose for which civil courts have been established, the conclusive resolution of disputes within their jurisdictions." *Montana*, 440 U.S. at 153.

The ruling of the CAFC in this case has disavowed this salutary rule insofar as it applies to the scope of a patent.

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[8] In an earlier case, a District Court had ruled that:

". . . no difference in substance is seen between interpreting language for purposes of validity and interpreting language for purposes of determining scope. The rationale of the *Blonder-Tongue* decision applies equally to both situations." *Iron Ore Co. of Canada* v. *Dow Chemical Co.*, 177 USPQ 34, 58 (D. Utah 1972), *aff'd*, 500 F.2d 189 (10th Cir. 1974).

See, also, Molinaro v. *Sears, Roebuck & Co.*, 478 F. Supp. 818 (S.D.N.Y. 1979); *Molinaro* v. *Hart Electronics Corp.*, 212 USPQ 697 (D. Pa. 1981).

POINT II

There is no unfairness in according collateral estoppel effect to final determinations of patent scope.

Since the *Mead* court decided its own jurisdiction, that issue was also entitled to collateral estoppel effect in this suit. *Underwriters Assur. Co.* v. *North Carolina Life,* 455 U.S. 691, 706 (1982); *Stoll* v. *Gottlieb,* 305 U.S. 165 (1938); *Restatement Second of Judgments,* 1982, § 12, espec. coments c. and d.; 18 *Wright, Miller & Cooper,* Federal Practice and Procedure, § 4428, pp. 271 *et seq.* (1981). The CAFC ruled, however, that regardless of jurisdiction, it is not without "discretion" to determine whether a particular case is appropriate for the application of collateral estoppel, and it exercised that discretion to deny collateral estoppel effect to the *Mead* court's ruling on scope. The CAFC relied on this Court's observations in *Parklane Hosiery* that the offensive use of collateral estoppel may, under some circumstances, be unfair.

There is little unfairness, however, in according finality, for defensive use purposes, to a judgment that has resolved an issue after a full and fair litigation. It is more unfair, as well as unwise, to deny finality under these circumstances. Indeed, the dangers in an unfettered discretionary application of the collateral estoppel rulings of this Court, when a full and fair opportunity to litigate in the first suit has not been questioned, are abundant. *Cf. Blumcraft of Pittsburg* v. *Kawaneer Company, Inc.,* 482 F. 2d 542, 547 (5th Cir. 1973); *Kaiser Industrial Corp.* v. *Jones & Laughlin Steel Corp.,* 515 F. 2d 964, 978-9 (3d Cir. 1975), *cert. denied,* 423 U.S. 876 (1975).

The CAFC ruling reflects a belief, without analyzing the close prior art considered by the *Mead* court, and without reviewing the Sweet file history before the Patent Office,

and the remainder of the extensive record in the *Mead* case, that the *Mead* court should not have made a determinative ruling on scope.

The appellate review of that ruling, however, should be pursued in the Court of Appeals for the Sixth Circuit—where the full record can be considered—if we are to have an orderly judicial system. From that tribunal, further appellate review can be sought in this Court, again with the full record in hand.[4]

Any rule which permits another court, without the record in hand, to deny finality to the first court's ruling, for defensive use purposes, where the issue has been determined after a full and fair opportunity to litigate, is both unfair to those relying on our courts and unworkable.

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[4] A review of the prior art and Patent Office file history by the District Court in the *Mead* case led to the following finding and conclusion of law:

> "It is clear that through such characterizations of Magarvey and Blackford and through the amendments to the claims which Sweet made in response to the rejection of the claims as fully met by Magarvey and Blackford, Sweet limited his invention to oscillography in which a picture of the incoming waveform is reproduced on paper by recording as a function of time the magnitude of deflection of each droplet in a succession so that the succession of deflected droplets trace the waveform on paper. This is the function and operation of an oscillograph. (Finding 71) (A 33)
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> • • •
>
> "Based on representations made to the Patent Office and amendments made to the claims in order to obtain the patent, A. B. Dick is estopped to construe the claims of the Sweet patent to claim other than an oscillographic recorder." (Conclusion 153) (A 59)

POINT III

The CAFC ruling raises unacceptable social and economic consequences.

The social and economic consequences of denying finality to determinations in patent cases were considered at some length in this Court's opinion in *Blonder-Tonque*. It continues costly litigation, involves inordinate trial time, taxes the overburdened federal courts, involves a misallocation of resources of many kinds, and interferes with predictability and decision-making for both patent owners and their competitors.

Before this misapplication of the law is permitted to take effect, it should be corrected. And there is no other forum for correction.

POINT IV

The CAFC has abrogated the role of the Federal Courts in determining the basically important question of the scope of a patent.

The CAFC ruling in this case has serious jurisdictional implications, inherent in the court's ruling that:

> "Except in the context of validity or infringement, judicial statements regarding the scope of patent claims are hypothetical insofar as they purport to resolve the question of whether prior art or products not before the court would, respectively, anticipate or infringe the patent claims." (A 117)

By characterizing the issue of scope as "hypothetical", except in the context of validity or infringement, the court has determined that no federal court jurisdiction exists as to the issue of scope except in these areas. U.S.

Constitution, Art. III, § 2, cl. 1; *Aetna Life Ins. Co.* v. *Haworth*, 300 U.S. 227, 239-42 (1937).

It thus precludes a declaratory judgment by one competitor against another, simply to adjudicate the scope of a patent, even where its scope is in dispute. As such, it precludes a judicial determination of the extent of a product line one can pursue, through financial, plant and personnel investment, without fear of injunction.

It even precludes one who has been sued for infringement from obtaining a construction of the scope of the patent asserted to be infringed, *beyond* the issue of whether the accused product infringes. This will necessitate needless litigation for each new product, as well as creating needless uncertainty.

Thus, while declaratory judgment relief remains available to determine the scope of a statute or contract, or the metes and bounds of real property, where those issues are in dispute, the decision in this case renders such relief unavailable to determine the scope of a patent, except in the resolution of validity or infringement.[5]

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[5] See, e.g., *Bowsher* v. *Merck & Co.*, 103 S. Ct. 1587 (1983) ("we must analyze the policies underlying the statutory provision to determine its proper scope"); *North Dakota* v. *United States*, 103 S. Ct. 1095 (1983) ("we state once again the obvious when we note that, in determining the scope of a statute, one is to look first at its language"); *North Haven Board of Education* v. *Bell*, 456 U.S. 512 (1982) ("Our starting point in determining the scope of Title IX is, of course, the statutory language."); *Montana* v. *United States*, 450 U.S. 544 (1981) ("This case concerns the sources and scope of the power of an Indian tribe to regulate hunting and fishing by non-Indians on lands within its reservation owned in fee simple by non-Indians."); *Abbott Laboratories* v. *Gardner*, 387 U.S. 136 (1967) ("These regulations purport to give an authoritative interpretation of a statutory provision . . .; its promulgation puts petitioners in a dilemma that it was the very purpose of the Declaratory Judgment Act to

(*footnote continued on following page*)

The importance of a patent's scope, both as a grant and a limitation, has been discussed in many decisions of this Court. *White* v. *Dunbar*, 119 U.S. 47 (1886); *Motion Picture Co.* v. *Universal Film Co.*, 243 U.S. 502, 510 (1917); *Carbice Corp.* v. *American Patents Corp.*, 283 U.S. 27, 31 (1931); *Leitch Mfg. Co.* v. *Barber Co.*, 302 U.S. 458 (1938); *Ethyl Gasoline Corp.* v. *United States*, 309 U.S. 436, 456 (1940); *Morton Salt Co.* v. *Suppiger Co.*, 314 U.S. 488, 492 (1942); *Mercoid Corp.* v. *Mid-Continent Co.*, 320 U.S. 661, 666 (1944); *Precision Co.* v. *Automotive Co.*, 324 U.S. 806, 816 (1945); *Zenith Corp.* v. *Hazeltine*, 395 U.S. 100, 136 (1969); *Blonder-Tongue* v. *University Foundation*, 402 U.S. at 343-4, 349-50; *Dawson Chemical Co.* v. *Rohm & Haas Co.*, 448 U.S. 176, 221 (1980).

To determine whether one is tying or otherwise controlling products that are outside the scope of a patent monopoly, or predicating royalty payments on such products, the scope must be determined—whether or not it is coupled with the issue of validity or infringement. The same is true as to the extent of an assignor's estoppel to challenge validity, *Westinghouse Co.* v. *Formica Co.*, 266 U.S. at 350, to the extent that this estoppel survives this Court's ruling in *Lear, Inc.* v. *Adkins*, 395 U.S. 653 (1969) (which terminated the doctrine of licensee estoppel).

(*footnote continued from preceding page*)

ameliorate."); *Skelly Oil Co.* v. *Phillips Co.*, 339 U.S. 667 (1950) ("this language in the contract may have a scope . . ."); *Maryland Casualty Co.* v. *Pacific Co.*, 312 U.S. 270 (1941); *cf. United States* v. *California*, 332 U.S. 19 (1947) ("We may assume that location of the exact coastal line will involve many complexities and difficulties. But that does not make this any the less a justiciable controversy."); and *cf. Westinghouse Co.* v. *Formica Co.*, 266 U.S. 342 (1924) ("The grantor purports to convey the right to exclude others in the one instance from a defined tract of land, and in the other, from a described and limited field of the useful arts. The difference between the two cases is only the practical one of fixing exactly what is the subject matter conveyed. A tract of land is easily determined by a survey. Not so the scope of a patent right for an invention.").

There is no basis for treating patent scope differently from any other issue. Where a real and immediate controversy exists as to the scope of a patent, that issue should be deemed justiciable, and subject to declaratory judgment relief—whether or not it is coupled with an issue of validity or infringement. *Cf. Aetna*, 300 U.S. at 293-42; *Maryland Casualty*, 312 U.S. at 272-4.

It is alien to fundamental concepts of jurisprudence to hold that our federal courts have jurisdiction to determine the validity of a patent, but not its metes and bounds, unless the latter determination is tied to validity or infringement. And it consequently cannot be the law of the land that federal courts are without jurisdiction to determine the issue of patent scope, since it is "hypothetical" to the extent that it deals with prior art or products not before the court.

CONCLUSION

For the reasons stated, a writ of certiorari should issue to review the judgment entered in this case by the Court of Appeals for the Federal Circuit.

Date:

Respectfully submitted,

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APPENDIX

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APPENDIX A

MEAD DIGITAL SYSTEMS, INC., Plaintiff,

v.

A. B. DICK COMPANY and Gould, Inc., Defendants.

A. B. DICK COMPANY and Gould, Inc., Plaintiffs,

v.

The MEAD CORPORATION, Defendant.

Nos. C-3-78-177, C-3-78-287.

United States District Court, S. D. Ohio, W. D.

Aug. 7, 1981.

Suit was brought for patent infringement. The District Court, Rice, J., held that: (1) claims 1 and 33 of patent No. 3,596,275 disclosing oscillographic for directly recording on paper a picture of wave form of electrical signal as a function of time was valid but not infringed, and (2) claim 2 of patent No. 3,298,030 for device requiring signals representation of "predetermined characters" for charging succession of ink droplets so that they are deflected to produce printing was invalid to extent it claimed invention of use of sine wave generator in connection with operation of another invention and it was invalid because differences between subject matter

sought to be patented and prior art were such that subject matter taken as a whole would have been obvious to person of ordinary skill in the art at time invention was made.

Judgment accordingly.

1. Patents ⇐283(1)

Equitable interest of third party in patent may not be asserted as defense in action for infringement brought by owner of legal title to the patent.

2. Patents ⇐290(3)

Maintenance of infringement action was not precluded by failure to join government as a party, even if one of patents in suit was developed in course of research project sponsored by United States so that government had equitable title.

3. Patents ⇐311

Since defendant in patent infringement case raised and then abandoned idea of joining government as a party in order to determine extent of government's interest in the patent, court had no jurisdiction to consider defendant's claim that title was in the government.

4. Patents ⇐312(2)

In patent infringement action, plaintiffs were not entitled to have exhibit added on ground that failure to offer it at trial was inadvertent, where exhibit was originally marked as defense exhibit, but was withdrawn by defendant at trial's end, and

plaintiffs were given opportunity to adopt exhibit but declined to do so and later sought to rely on exhibit to defend against defendant's assertion that one of the patents in suit was invalid.

5. Patents ⇐312(1¾)

In infringement suit, defendant who asserts laches has burden of proving unreasonable delay by plaintiff in filing suit after first notice of infringement, but defendant is aided by presumption which is derived from statutory period of recoverable damages. 35 U.S.C.A. § 286.

6. Patents ⇐289(4)

Plaintiff in infringement suit filed longer than six years after notice of infringement will be barred by laches unless he can rebut presumption of unreasonableness in delay by showing good excuse therefor, rebut presumption of prejudice, or show such egregious conduct on defendants' part that equities otherwise weigh in plaintiff's favor. 35 U.S.C.A. § 286.

7. Patents ⇐289(4)

Defendant's own initially uncertain plans for development of allegedly infringing printer and commercial uncertainty of printer for extended period thereafter were sufficient basis for concluding that plaintiff's delay in filing patent infringement suit in excess of six years was not unreasonable as matter of fact and did not preclude

prosecution of infringement action on theory of laches. 35 U.S.C.A. § 286.

8. Patents ⇐167(1¼, 1½)

Ambiguous claims in patent must be read in light of invention disclosed and cannot be given construction broader than teachings of patent as shown by drawings and specification.

9. Patents ⇐165(4)

Since patent disclosed only oscillographic recording, scope of its claim was limited to oscillographic recording.

10. Patents ⇐165(2)

Patent must be judged by what is claimed for it in patent application, not by what is asserted in subsequent litigation.

11. Patents ⇐328(2)

Claims 1 and 33 of patent No. 3,596,275 disclosing oscillographic for directly recording on paper a picture of wave form of electrical signal as a function of time were valid but not infringed. 35 U.S.C.A. § 103.

12. Patents ⇐328(2)

Claim 2 of patent No. 3,298,030 for device requiring signals representation of "predetermined characters" for charging succession of ink droplets so that they are deflected to produce printing was invalid to extent it claimed invention of use of sine

wave generator in connection with operation of another invention and it was invalid because differences between subject matter sought to be patented and prior art were such that subject matter taken as a whole would have been obvious to person of ordinary skill in the art at time invention was made. 35 U.S.C.A. §§ 102(f), 103, 282.

13. Patents ⇐237

Accused device may be found to infringe on patent, if not literally, as equivalent of claimed invention, if accused device performs substantially same function in substantially same way to obtain the same result.

14. Patents ⇐112.1

Presumption of validity of patent gives grant substance and value but is not conclusive, presumption has no independent evidentiary value in infringement litigation and it serves only to place burden of proof on party who asserts invalidity as defense to infringement. 35 U.S.C.A. § 282.

David C. Greer, Howard P. Krisher, Dayton, Ohio, Dugald S. McDougall, Keith V. Rockey, Chicago, Ill., for A. B. Dick Company & Gould, Inc.

Armistead W. Gilliam, Jr., Dayton, Ohio, Bill Durkee, Edward W. Goldstein, Ben D. Tobor, Houston, Tex., for Mead Corp.

Appendix A

OPINION

PRELIMINARY MATTERS DISPOSED OF; A. B. DICK NOT PRECLUDED FROM PROSECUTING INFRINGEMENT ACTION BY LACHES; MEAD *DIJIT* PRINTER HELD NOT TO INFRINGE, LITERALLY OR AS AN EQUIVALENT, ON CLAIMS 1 OR 33 OF SWEET PATENT OR ON CLAIM 2 OF LEWIS–BROWN PATENT; SWEET PATENT DEEMED VALID; LEWIS–BROWN PATENT DEEMED INVALID; DEFENDANT TO PREPARE JUDGMENT ENTRY WITHIN STATED PERIOD OF TIME IN ACCORDANCE WITH THIS OPINION

RICE, District Judge.

I.

This case brings before the Court two patents in the field of ink jet printing and a device, the Mead DIJIT printer, which is alleged to infringe on those patents. The case came on for trial before the Court sitting as the trier of fact. Certain preliminary matters are addressed immediately below. The Court's findings of fact and conclusions of law, as required by Fed.R.Civ.P. 52(a), are set forth further below.

Appendix A

II.

Because one of the patents in suit (the Sweet patent) was developed in the course of a research project sponsored by the United States Government, Mead says that the Government has equitable title thereto under the common law and pursuant to federal regulations. Since the Government is not a party to this action in infringement, and since the law requires that every owner of a patent must be joined before an infringement suit can be maintained, Mead contends that this action in infringement of that patent cannot be maintained.

[1–3] Although, as Mead points out, there is a conflict among reported decisions on this matter, this Court must conclude, in accord with the great weight of authority, that the equitable interest of a third party in a patent may not be asserted as a defense in an action for infringement brought by the owner of legal title to the patent. *See Mercantile Nat'l Bank of Chicago v. Howmet Corp.*, 524 F.2d 1031, 1034 (7th Cir. 1975), *cert. denied*, 424 U.S. 957, 96 S.Ct. 1435, 47 L.Ed.2d 364 (1976), and cases cited therein. The Court also notes that Mead raised and then abandoned the idea of joining the Government as a party, herein, in order to determine the extent of the Government's interest in the patent. This Court concludes that it is without jurisdic-

tion to consider Mead's claim that title is in the government. *See also Mead Corporation and Mead Digital Systems, Inc. v. United States of America, et al.*, 652 F.2d 1050 (D.C.Cir.1981).

Accordingly, the Court does not consider the question of the Government's interest in the Sweet patent in the findings and conclusions set forth below.

After the close of the evidence in this case, plaintiffs * moved for an order enlarging the record by the addition of two exhibits. Mead does not object to the addition of the first exhibit, the Donahue deposition, and accordingly, it will be added to the record as plaintiffs' exhibit A–237. The Court notes, in passing, that plaintiffs rely on this exhibit as evidence of Mead's interest in acquiring a license under one of the patents in suit (Lewis-Brown), and to challenge Mead's assertion in its brief that plaintiffs proposed findings were incorrect on this matter. Since the Court finds and concludes below that the accused device does not literally infringe, nor infringe as an equivalent of that patent, the question

* Because this action is a consolidation of two cases, one of which involves A. B. Dick and Gould as Plaintiffs and the other of which includes Mead as Plaintiff, the parties have agreed that, for purposes of the trial, A. B. Dick and Gould would be referred to as Plaintiffs and Mead as Defendant. (Pg. 2, Final Pretrial Order, 10/29/80).

of Mead's interest in the patent during the development of the accused device is wholly irrelevant.

[4] Mead does object to the second exhibit which plaintiffs seek to have added to the record. Plaintiffs seek to have the second exhibit added on grounds that the failure to offer it at trial was "inadvertent." The exhibit in question was originally marked as a Mead exhibit but was withdrawn by Mead at the trial's end. Plaintiffs were given the opportunity to adopt the exhibit but declined to do so. Plaintiffs now seek to rely on the exhibit to defend against Mead's assertion that one of the patents in suit (Sweet) is invalid.

Under the circumstances, the Court is not satisfied that Plaintiffs' failure to offer the exhibit at the close of trial was inadvertent. Accordingly, the exhibit will not now be added to the record. However, while the Court notes that the exhibit is relevant to the issue of one of the inventor's disclosures to the patent office, the Court further notes that the exclusion of the exhibit does not prejudice plaintiffs since the Court finds and concludes below that the particular disclosure in question (or, more correctly, failure to disclose) does not affect the validity of the inventor's patent.

Finally, it will be noted that the Court finds and concludes below that the accused device does not infringe either of the pat-

ents in suit. Although it is not necessary to address the *validity* of the patents in suit under such circumstances, the Court is of the opinion that the public importance of and public interest in the validity of the patents in suit, as well as the substantial cost borne by the parties in litigating the matter, dictate that the Court determine the validity issues presented to it. The Court notes that such comprehensive disposition of infringement suits has been approved in this Circuit as "the better procedure." *Tappan Co. v. General Motors Corp.*, 380 F.2d 888, 890 (6th Cir. 1967).

III.

Findings of Fact

A. *The Parties, Patents in Suit, and Proceedings*

1. A. B. Dick Company (hereafter "A. B. Dick") is a Delaware corporation, having its principal place of business in Chicago, Illinois. Gould, Inc. (hereafter "Gould") is also a Delaware corporation, and has its principal place of business in Rolling Meadows, Illinois.

2. The Mead Corporation is an Ohio corporation, having its principal place of business in Dayton, Ohio. Mead Digital Systems, Inc., also an Ohio corporation, is a wholly-owned subsidiary of The Mead Corporation. For sake of brevity, The Mead Corporation and Mead Digital Systems,

Inc., will be referred to collectively as "Mead."

3. All the parties have a regular and established place of business in the Southern District of Ohio. No issue as to jurisdiction or venue is involved.

4. United States Patent No. 3,596,275 (the "Sweet patent") issued on July 27, 1971, on an application filed on March 25, 1964. That application was called a continuation-in-part of an earlier application filed July 31, 1963. On September 19, 1972, the inventor named in that patent, Richard G. Sweet, executed an assignment conveying his entire right, title and interest in U. S. Patent No. 3,596,275 to A. B. Dick.

5. United States Patent No. 3,298,030 (the "Lewis-Brown patent") issued on January 10, 1967, on an application filed July 12, 1965, and names Arthur M. Lewis and Arling Dix Brown as the inventors. That application was called a continuation-in-part of an earlier application filed on January 13, 1965, which in turn was called a continuation-in-part of yet an earlier application filed September 25, 1964. Gould is the owner of that patent, and A. B. Dick is the exclusive licensee under it.

6. A. B. Dick and Gould first filed suit in Chicago against The Mead Corporation for infringement of the Sweet patent and the Lewis-Brown patent, based upon Mead's development and use of a printing system called the DIJIT printer. Mead Digital

Systems, Inc., thereafter filed an action for declaratory judgment before this Court, seeking a declaration that Mead Digital Systems, Inc., has not infringed either of the patents in suit. (Case No. C–3–78–177). The Chicago case was, with the consent of all the parties, transferred to this Court where it was consolidated with the declaratory judgment action brought here by Mead Digital Systems, Inc. (Case No. C–3–78–287).

B. *The Art Prior to Sweet*

7. In the 19th century, Lord Rayleigh investigated the scientific phenomenon that a stream of liquid drops issuing from a nozzle could be made uniform in size and spacing by imparting cyclic energy (vibrations) to the liquid as the drops formed at the nozzle tip.

8. The basic concept of recording electric signals on paper with a controlled jet of ink has been known for some years. In claim 4 of the Schroter Patent, No. 1,882,-043, which issued in 1932, one aspect of the Schroter invention is described as follows:

> The method of recording signals on a recording surface in accordance with received signal energy impulses which includes continuously projecting a jet of recording fluid along a predetermined path toward the recording surface, electrically deflecting the path of the record-

ing jet in accordance with received signal energy impulses, producing markings by the recording jet upon the recording surface during periods of deflection, and interrupting the marking action during the absence of electrical effects producing deflections in the jet.

The Schroter patent also discloses the concept of moving the paper past the jet to effect recording (e. g., claim 8). The Schroter patent does not discuss use of a jet consisting of a succession of uniform ink droplets, but it does disclose that electric signals for recording can be used either to control the instantaneous intensity of charge of the jet or to control the intensity of the deflecting electric field.

9. The Jacob patent, No. 2,577,894, issued in 1951, discloses an ink jet system operated in a binary or on-off manner in which ink or other marking medium is directed to a recording surface with one charge value, or is intercepted before recording by another charge value at a different level. Jacob's device contemplates recording electronic signals through the use of a marking mist or spray consisting of a jet of air containing ink particles.

10. In 1956, Harold Waage at Princeton University published his observation that a uniform succession of water droplets could be produced, in accordance with the principles of Lord Rayleigh, and that the droplets could then be deflected in an electrostatic

field in a manner analogous to deflection of electrons in a cathode ray tube. The report of Waage's experiments did not suggest a recording use, but only primary observation of the characteristic movements of the droplets under a stroboscope and with mirrors.

11. Between 1956 and 1962, R. H. Magarvey published studies, first with B. W. Taylor and then with B. L. Blackford, in the area of inducing charges on water drops. The Magarvey art concerns induction charging of individual water droplets produced by a vibrated nozzle, and describes a device and experiments which involve the breakup of water from a nozzle and headphone arrangement into a stream of uniformly sized and spaced droplets; an induction ring which charges drops passing through it; a manually varied voltage supply to the induction ring; an electrode for electrostatically deflecting the charged drops as a function of the charge of the drops; and a collector for receiving the charged drops. In the earlier Magarvey studies, in 1956, he deflected charged water droplets in a varying electrostatic field to separate some droplets from others which were intercepted. Magarvey also added blue aniline dye to the water to aid photography of the droplets against a white background. Magarvey did not disclose any printing or recording use for his device.

12. In the late 1950's, Charles R. Winston at Teletype Corporation made an ink jet printer which sold commercially for sev-

eral years as the Teletype Inktronic. U. S. Patent No. 3,060,429 issued to Winston in 1962 based on a disclosure filed in 1958. The Winston printer involved an ink supply under slight fluid pressure, formation of uniform highly charged ink droplets, movement of paper across the path of the ink droplets for marking, deflection of some ink droplets to intercept them and to keep them from marking the paper, and controlled electrostatic deflection of other ink droplets to effect marking at the proper location on the paper. It also included a function generator to vary the strength of the electrostatic field through which the ink drop passes. Variations of the strength of that field caused the drops to deflect varying amounts and to strike the paper in the correct place. The Winston printer did not employ a constant stream of ink droplets formed by fluid pressure; rather, it employed an attractive electrostatic force, located on the opposite side of the paper from the nozzle, to draw the ink droplets from the nozzle whenever ink droplets were desired. Although Teletype Corporation has discontinued sale of the Winston printer, some of the printers are still in use today.

C. *Sweet's Work and Related Activities*

13. Richard G. Sweet is an electrical engineer, conducting electronics research in the laboratories of Stanford University. In 1961, Sweet was given, as a gift, an aquarium equipped with an air stone for putting

oxygen into the water for the fish to breathe. Being a curious scientist, Sweet wondered how oxygen from the air was transferred from the bubbles released into the aquarium to the water, and did some research to find out. That research led Sweet to an old book entitled *Soap Bubbles*, based on lectures given in England in the 1890's by Sir Charles Boys. That book contained a chapter describing how a small fluid jet broke up into uniformly spaced and sized droplets which could be electrostatically deflected. Boys had used a tuning fork to vibrate the nozzle to produce disturbances on the fluid jet and to cause it to break up into the stream of uniform droplets.

14. Sweet was intrigued by Boys' experiments, having in mind:

> "... a rather vague idea that one of the vague applications of this might be some kind of writing device in which the droplets, since they were very small, it might be possible to move them more rapidly than one could move a mechanical system such as those that I was familiar with."

Sweet was familiar with, for example, moving pen recorders of the kind used to make electrocardiograms. Sweet conducted experiments repeating Boys' work.

15. Sweet's initial thought was to apply an intelligence or information signal to a deflection mechanism so that droplets

would be deflected in the same fashion as electrons are deflected in a cathode ray tube. That did not work well, however; because of the slow speed and large mass of inkdrops as compared to electrons, that type of deflection system had a very low frequency response. So Sweet searched his mind for a better way; he testified:

> "And it was at that point that I was searching for some way to get around that limitation, that the idea of actually charging the droplets and having the droplets carrying the information occurred to me."

16. Sweet next undertook to determine the physics of the drop-charging process, a phenomenon not clear to him from Boys' work. Sweet discovered that, unlike Boys who charged and deflected droplets with a single electrode, he could charge the droplets separately from the deflection process by providing a separate electrode to charge the droplets before they were deflected. That convinced Sweet that he had something; in such a device, the frequency response would depend only on the rate at which droplets could be formed. All that was necessary was that the charging electrode be at the desired voltage at the instant the droplet was formed; after the droplet was formed, its charge was "fixed."

17. At that point in early 1961, Sweet assembled "a very crude system" consisting of a nozzle fed with tap water, a miniature

loud speaker to stimulate the nozzle, a charging electrode and a pair of deflection plates, to enable Sweet to study the trajectories of the deflected droplets and to learn how they responded to various signal waveforms applied as charges to the droplets. That system was sketched in Sweet's laboratory notebook in July of 1961.

18. Sweet had kept his group leader, R. C. Cumming of the Stanford Electronics Laboratory, fully apprised of what he had been doing in this research. Cumming expressed interest, and suggested that the two of them approach the Army Signal Corps, with whom Stanford already had a research contract, to see if the Signal Corps would provide financial support for Sweet's project.

19. The contract monitor for that contract, Ira O. Myers of the Army Signal Corps, paid Sweet and Cumming a visit in the month following the date of Sweet's sketch. Sweet showed Myers his crude apparatus, hoping that Myers would give him some encouragement. Myers expressed interest and asked Sweet for a formal proposal. On September 13, 1961, Cumming wrote to Myers, forwarding to him Sweet's written proposal.

20. Myers responded promptly, suggesting that a working model be fabricated for laboratory testing. The project was then formally established, and in early 1962 Sweet began his experimental work under the auspices of the Army Signal Corps.

21. Under the Signal Corps Contract, quarterly technical reports were required concerning the Sweet project.

22. The quarterly reports on the Sweet project were combined each quarter with reports on other projects in a consolidated report, designated a Consolidated Quarterly Status Report ("CQSR"). The first relevant CQSR, namely, report No. 31, was distributed by Stanford University and received prior to July 31, 1962, by the private and governmental organizations, libraries, universities, persons, and other entities listed in its distribution list appearing at the end of the CQSR.

23. The second and third relevant CQSRs, namely reports Nos. 32 and 33, were distributed by Stanford University and received prior to March 25, 1963, by the numerous organizations, libraries, universities, persons, and other entities listed in their respective distribution lists.

24. All of the quarterly reports on the Sweet project were unclassified. Even though the CQSRs were confidential, the individual Sweet quarterly reports all bear the word UNCLASSIFIED with the title.

25. Sweet's project under the Signal Corps Contract was not at any time assigned any Government security classification. While Sweet's work was carried out in a building of the Stanford Electronics Laboratories in which classified research was being carried out, visitors without se-

curity clearance were permitted in the area of Mr. Sweet's work, and Mr. Sweet was free to demonstrate his work to anyone.

26. Sweet's first job in the laboratory, upon obtaining the government contract, was to increase the droplet frequency, that is, the rate at which the droplets issued from the ink nozzle. The prior work of Boys, and other literature references tracked down by Sweet, described liquid jets having droplet frequencies of a few hundred drops per second. Sweet, in contrast, was interested in droplet rates greater than 20,000 per second. Within a very short time, Sweet succeeded in producing 100,000 droplets per second, a rate he found suitable for recording. He made his first record in April of 1962.

27. Sweet's first record was a replication of a sine-wave input signal, a type of signal readily available in the laboratory and commonly used by engineers to evaluate the frequency response of electronic equipment.

28. Annual Contractors and Stanford Technical Advisory Committee (TAC) meetings were held at Stanford University each August during the early 1960's to demonstrate the research products developed at Stanford to those who attended the meetings. Those meetings were attended by members of Stanford's Technical Advisory Committee and by representatives of Government contractors, on an invitation-

only basis. Sweet's laboratory was located in an area secured by guards, to protect the security of classified work which was being conducted there.

29. By the time of the annual Contractors and TAC meetings in August, 1962, Mr. Sweet's recorder had been reduced to practice and he demonstrated a model of the recorder at those meetings. These demonstrations were open to all attendees at the meetings who were interested in seeing it. In addition to the actual demonstration, Mr. Sweet had copies of waveforms posted in the area of his demonstration.

30. There were no constraints of any kind placed upon the attendees at the 1962 Contractors and TAC meetings, as to their subsequent disclosure or use of any information they obtained concerning the Sweet recorder or the Sweet project.

31. Some time after the August, 1962, TAC meeting, Sweet observed that when this input signal was changing rapidly, an error resulted in the charge on one drop of ink. That drop, as a result, would not strike the paper precisely where it was supposed to. Sweet corrected that condition by wiring into his system a standard compensating or tone-control circuit like that employed in audio systems.

32. After the Sweet direct-writing oscillograph had been reduced to practice, and had been demonstrated at the August, 1962, Contractors and TAC meetings, Sweet con-

tacted various industry members to interest them in commercializing his recorder.

33. In October and November, 1962, Sweet sent letters to several manufacturers of recording instruments, for the purpose of finding:

> "... a commercial concern that would do some development of the system to commercialize it and hopefully under some kind of [licensing] arrangement with me."

Such letters were sent to Brush Instruments, Honeywell, and Hewlett-Packard, among others.

34. Sweet ultimately granted an exclusive license to his invention to Honeywell. The Honeywell license obligated Sweet to submit to Honeywell a complete disclosure of his invention. He did so on March 6, 1963.

35. Sweet's disclosure to Honeywell outlined what his invention was and how it worked. He noted that his invention contained the following elements:

(a) A means for supplying ink under pressure;

(b) A "nozzle or orifice" from which the ink issues as a "free jet";

(c) A means "for causing the jet to break up into regularly-spaced droplets of uniform size";

(d) A charging electrode for charging the ink droplets in proportion to the signal to be recorded;

(e) A deflection system to deflect the charged droplets, utilizing "a uniform DC electric field";

(f) A recording device on which the record can be made; and

(g) A transport system to advance the record surface during recording.

36. In his Honeywell report, Sweet noted several "possible modifications and variations" to the basic system. One was a means of diverting from the record surface a portion of the ink issued from the nozzle to control the intensity and width of the recorded trace. Unwanted or excess ink droplets, Sweet noted, could be disposed of by simply deflecting them to a catcher, without their ever reaching the record member. That deflection technique for intensity control was still on the drawing board, however, as Sweet noted that it was a feature which was being tested.

37. In the period following his entering into a contract with Honeywell, Sweet continued to test his system. For example, by March 31, 1963, Sweet had reported tests of his catcher.

D. *The Sweet Patent Applications*

38. Sweet's agreement with Honeywell provided that Honeywell would prepare and file, on Sweet's behalf, patent applications on Sweet's invention. Honeywell's rights were, however, subject to the right of the U.S. Government to receive a royalty-free license.

39. The first Sweet patent application was filed by Honeywell on Sweet's behalf on July 31, 1963. It disclosed the same device, which Sweet had demonstrated at the TAC and Contractors meetings in August of 1962.

40. That first Sweet patent application did not include a disclosure of the concept of, or apparatus for, deflecting ink droplets to a catcher. At the time the first application was filed, that concept was still in the evaluation stage. Later in 1963, Sweet visited Honeywell's facilities in Denver on a regularly-scheduled consultation visit, at which time it was decided that deflection to a catcher was a valuable improvement which should be included in Sweet's patent. A continuation-in-part (CIP) application to that end was filed on March 31, 1964, and the first application was thereupon abandoned in favor of its successor.

41. The second Sweet patent application, Serial No. 354,659, included all of the disclosure of the original application plus some new drawings and descriptive text relating to them. The new disclosure thus added to the CIP application material related to the catcher, its associated circuitry, and its utility in disposing of unwanted ink drops.

42. During the course of the prosecution of the Sweet CIP application, the Patent Office examiner cited a number of prior-art references, many of which are relied upon

by Mead. After a lengthy prosecution, the Patent Office allowed the Sweet CIP application, and it issued on July 27, 1971, as U. S. Patent No. 3,596,275.

43. Although Sweet knew of Waage's work (Finding of Fact # 10, page 6, *supra*) as early as 1962, he did not cite it to the patent office during the prosecution of his application. Sweet wrote to his attorney in 1970 that he considered the Waage publication to be the "closest prior art" in the field of drop generation for purposes other than writing or recording.

44. Mr. Sweet testified that he knew during the development of his device that it was "critical" that ink having the correct properties be used in the device in order to achieve proper operation. However, he further testified that he had found that every ink he had used "that would squirt through the nozzle worked satisfactorily." There was no disclosure regarding ink properties in either the first or the second Sweet patent applications.

45. Mr. Sweet also testified that his "best system" prior to the filing of his first patent application included a compensating network for drop-placement error. (See Finding of Fact # 31, page 12, *supra*). However, he further testified that he thought the compensating circuit "usually was not needed." There was no disclosure regarding ink properties in either the first or the second Sweet patent applications.

46. Sweet's license to Honeywell had continued as an exclusive license until September, 1965, when Honeywell converted it to a non-exclusive license. On September 9, 1969, Honeywell terminated its non-exclusive license.

47. A. B. Dick had first become a licensee of the Sweet invention in May, 1966. Thereafter, on September 19, 1972, A. B. Dick bought Sweet's patent outright, subject to other licenses earlier granted.

E. *The Sweet Patent*

48. A waveform is the pictorial representation of the form or shape of a wave with respect to time.

49. The Sweet patent describes a recording system in which the waveform of an incoming electrical signal is recorded on paper.

50. The waveform is recorded, in accordance with the Sweet patent disclosures, by the imprint of uncharged and variably charged ink droplets on various positions on a paper. In every embodiment disclosed in the Sweet patent, the waveform of a continuously varying signal is recorded by a process which involves: charging each ink droplet in a succession of droplets in proportion to the instantaneous value, including zero, of an electric signal which varies as a function of time; and then passing the variably charged droplets through a constant

deflection field to deflect the droplets through variable trajectories in order to produce on the paper a trace of the incoming waveform.

51. As defined by the McGraw-Hill Encyclopedia of Science and Technology, an oscillograph is:

> A measurement device for determining waveform by recording the instantaneous values of a quantity such as voltage, as a function of time. It consists of three major components: (1) a primary detector for sensing the instantaneous values of the quantity, (2) the timing system for introducing a time scale on the record, and (3) some means for recording the waveform.

52. The testimony at trial was consistent that the Sweet patent discloses only an oscillographic device.

53. Richard G. Sweet, the inventor of the patent, testified:

> Q. Sir, isn't it true that the only direct writing recorder disclosed in your patent is an oscillograph?
>
> A. As we defined it, yes.

54. Dr. Joseph M. Crowley, an expert witness called by A. B. Dick, testified:

> Q. Is there anything disclosed in the Sweet patent which shows anything other than an oscillograph?
>
> A. I don't recall anything.

55. Mr. Lockwood Burton, the attorney who drafted the Sweet patent, testified:

Q. Did you consider that Mr. Sweet had developed an invention in the field of oscillography?

A. Yes.

Q. In any other field?

A. No other field was concerned.

56. Dr. Charles Hendricks, an expert witness called by Mead, testified:

Q. Does the Sweet patent disclose an oscillograph?

A. Yes, it does.

Q. Does it disclose any other kind of device?

A. No.

57. The Sweet patent discloses a direct writing oscillograph for directly recording on paper a picture of the waveform of an electrical signal as a function of time. The Sweet patented device reproduces an apparently cursive waveform of the incoming signal. It is not capable of printing pictures of something other than a waveform.

58. In the Sweet patent, interception and collection of some of the droplets by deflection to a catcher serves only the purpose of controlling intensity of the trace to prevent puddling associated with excess ink when the paper is moving slowly or where the waveform is not changing quickly. Under such circumstances, a cursive representation of the incoming signal or waveform

is still recorded; the cursive trace on paper is a cleaner representation of the incoming signal due to the elimination of puddling.

Technically, the apparently cursive waveform produced by the Sweet device is discontinuous, in that it is composed of discrete droplet imprints rather than a continuous stream. However, the waveform produced by the Sweet device appears continuous by virtue of the overlapping or close juxtaposition of the droplet imprints. The interception facility in the patented Sweet device does not serve the purpose of creating an apparent discontinuity in any portion of the waveform, but only to adjust the density of the waveform by increasing the distance between droplet imprints.

59. The Sweet patent discloses deflection of the charged drops in a direction transverse to the time axis of the trace, which ordinarily is transverse with respect to the direction of relative movement between the paper and the nozzle. Such transverse deflection is essential in order to operate the device of the Sweet patent to record a waveform on paper. Sweet does not disclose, or illustrate in any embodiment, a deflection of the drops other than in this direction. Deflection of the charged drops longitudinally with respect to the relative movement between the paper and the nozzle in the oscillograph disclosed by Sweet would produce an inoperative device.

60. Certain embodiments in the Sweet patent do disclose deflection of charged

drops longitudinally with respect to the relative movement between the paper and the device as a whole. However, in each such embodiment, the nozzle rotates and the direction of the deflection remains substantially transverse the time axis of the trace, which is substantially transverse of the direction of relative movement between the nozzle and the paper.

61. Claims 1 and 33 of the Sweet patent are the only claims of that patent asserted against Mead in this case. Both claims describe charging each droplet in a single file succession, with the magnitude of each charge being proportional to the instantaneous value of an electric signal which varies as a function of time, and deflecting the droplets to take different trajectories as a function of the magnitude of charge associated with the droplet so that the droplets form a trace characteristic of the variable input signal on the recording surface. This description refers to oscillographic recording and is consistent with the overall disclosure of the Sweet patent.

62. Claim 1 specifically requires that charged drops be deflected "laterally." This term is ambiguous since alone it may mean deflection "lateral" of the undisturbed stream of droplets emitting from the nozzle, including deflection longitudinal of the relative movement between the nozzle and the paper, *or* it may only mean deflection "lateral" of the relative movement between the nozzle and the paper.

63. Claim 33 requires deflection of charged droplets along different "trajectories" for collection in different "regions" of the collecting device. This claim is ambiguous in the same manner as claim 1.

64. The Sweet patent only discloses deflection of charged droplets in a direction transverse of the direction of relative movement between the paper and the nozzle, and both claims must be read in light of this limited disclosure. Deflection of ink droplets in a direction longitudinal of the direction of relative movement between the paper and nozzle would cause the device disclosed in the Sweet patent to be inoperative.

65. Claims 1 and 33 of the Sweet patent describe an oscillographic method and recorder.

66. The construction of the Sweet patent and its claims as limited to oscillography is also consistent with the history of prosecution before the Patent Office of the 1964 application which became the Sweet patent.

67. In examining the Sweet application on July 31, 1970, the Examiner rejected applications claims 30 and 51, which became respectively claims 33 and 1 of the Sweet patent, as being "fully met" by the Magarvey and Blackford study. (See Finding of Fact # 11, page 6, *supra*). It was the position of the Examiner that the Magar-

vey and Blackford publication taught each feature of claims 30 and 51 of the Sweet application.

68. In response to the rejection of the claims as fully met by Magarvey and Blackford, Sweet amended the claims to include the word "variable" with respect to the electrical signal values. The claims then read as they now read in the Sweet patent "applying variable electrical signal values representative of the desired deflections to the charging electrode whereby individual droplets are electrostatically charged . . . ." The claims were further amended to recite that the droplets which have different charges move through different trajectories.

69. As indicated in Finding of Fact # 11, above, none of Magarvey's publications taught a printing or recording use for his droplet deflection device. Sweet pointed this out to the patent office examiner. However, in doing so, Sweet made the following representation to the patent office "for clarification and to place the case in condition for immediate allowance":

> Obviously the Magarvey and Blackford publication does not teach the concept of a high speed jet recorder or printer in which droplets are first electrostatically charged in accordance with the instantaneous values of a varying signal and thereafter individually *deflected by varying amounts* dependent upon said signal

by projecting the charged droplets through a fixed electrostatic field. Lastly, it does not in any way anticipate the concept just described as applied *to deposit the deflected droplets on a record medium to produce a pattern or design characteristic of the signal variations.*

70. Mr. Adelman, an expert witness called by Mead, testified in regard to the position taken by Sweet to gain allowance of his patent:

A. Taking those remarks in the context of the specific amendment and viewing the Magarvey reference, it is my opinion that when the language is so read, one must conclude that in the Patent Office, Mr. Sweet was by virtue of the rejection limiting the scope of his claims to an oscillograph.

71. It is clear that through such characterizations of Magarvey and Blackford and through the amendments to the claims which Sweet made in response to the rejection of the claims as fully met by Magarvey and Blackford, Sweet limited his invention to oscillography in which a picture of the incoming waveform is reproduced on paper by recording as a function of time the magnitude of deflection of each droplet in a succession so that the succession of deflected droplets trace the waveform on paper. This is the function and operation of an oscillograph.

F. *Lewis' and Brown's Work*

72. Maurine Hartley, of Brush Instruments, responded to one of Sweet's letters regarding commercialization of his oscillograph in late 1962. Hartley visited Sweet at Stanford. Upon his return to Brush, Hartley discussed Sweet's device with his assistant, Arling Dix Brown.

73. Within a very short time, Brown and his colleague Arthur M. Lewis began working on a drop writer. They subsequently undertook development work on a machine which would utilize Sweet's inventive concepts to print alphanumeric characters.

74. The original Lewis-Brown machine, which was first tested in July, 1963, utilized a "character generator" which included storage means for letters and numerals and a mechanism for generating distinctive voltage signals corresponding to the letters and numerals. A pre-determined sequence of characters and numerals (i. e., a message) was programmed on a disk and then the disk was scanned optically to convert the optical signals into electrical signals for printing the message stored on the disk. That character printer could be operated at 1200 to 2400 characters per second.

75. The character printer used in July, 1963, at Brush did not physically incorporate an interceptor or catcher for collecting unwanted or excess ink droplets. Instead, such droplets were simply deflected to a

"dump line" which appeared as an underscoring of the printed message.

76. That same printer was demonstrated to A.B. Dick in February of 1964. During that demonstration, Lewis and his colleagues at Brush employed, for the first time, a collector to receive the unwanted ink drops.

G. *The Lewis and Brown Patent Applications*

77. The first Lewis-Brown application was filed on September 25, 1964. That application, No. 399,291, included a description of the Lewis-Brown character printer, which included a nozzle and a means to vibrate the nozzle to produce a succession of uniformly-sized and uniformly-spaced ink droplets. Each droplet, as it was formed, was given an electrical charge characteristic of a predetermined character such that, when the varying-charge droplets were passed between a pair of constant-voltage deflection plates, the droplets were subjected to varying deflections to print the letter or numeral selected. (Lewis and Brown had recognized that the character generator could be a purely electronic device, as opposed to the electro-mechanical version they had tested in their laboratories. They accordingly described in their patent application such an all-electronic function generator.) Ink droplets not needed for printing were, as in the Sweet device, deflected to a catcher.

78. A second Lewis-Brown patent application was filed a few months later; it was Serial No. 425,162, filed January 13, 1965, and it contained essentially the same disclosure as the earlier one.

79. On July 12, 1965, Lewis and Brown filed the last of their applications, Serial No. 471,259. That application contained the same disclosure as the earlier applications, plus description in greater detail of the electronics for controlling the function generator.

80. The prosecution of the final Lewis-Brown application was very brief, the Patent Examiner having allowed on the first Office Action all of the claims as they were presented. Four prior-art references were cited, including an earlier publication by Sweet describing his invention and the use, in conjunction therewith, of a sine-wave generator.

81. The Lewis-Brown patent issued on January 10, 1967, and A. B. Dick became and is the exclusive licensee under it.

H. *The Lewis-Brown Patent*

82. The Lewis-Brown patent discloses a device for printing predetermined characters by using a function generator to control the signals applied to the Sweet device. The only function generator disclosed produces an analog staircase waveform capable of deflecting ink droplets to many different

locations to print an alphanumeric character. The patent refers to prior art Patent No. 2,958,828 as providing a suitable function generator.

83. The Lewis-Brown patent, like the Sweet oscillograph, only discloses deflections of the ink droplets which print in a direction transverse of the time axis of relative movement between the ink jet and the paper. It is disclosed that droplets are deflected to many locations transverse of the time axis, with seven different transverse printing locations being disclosed in the patent.

84. The Lewis-Brown patent defines "the word character or characters ... to include ... nonalphanumeric designs such as waveforms and various geometric configurations."

85. Claim 2 of the Lewis-Brown patent, the only claim alleged against Mead by A.B. Dick and Gould, requires signals representative of "predetermined characters" for charging the succession of droplets so that droplets are deflected in accordance with the signals to produce characters on a record from a single nozzle.

86. Without deflection, or with deflection longitudinal of the relative movement of the paper and a single nozzle, the Lewis and Brown device is incapable of producing more than one "character," being a straight-line waveform. In order to be ca-

pable of producing alphanumeric designs, geometric configurations, or common nonlinear waveforms, as required by claim 2, the Lewis and Brown device requires deflection *lateral* of the direction of the relative movement between the paper and a single nozzle, much like the Sweet patent.

87. The Lewis-Brown patent claims a method for generating a multiplicity of characters by use of a single nozzle.

I. *The Interference Proceeding*

88. After the Lewis-Brown patent issued in January, 1967 (while Sweet's application was pending), Sweet copied claims from it, provoking an interference proceeding between Lewis-Brown and himself to determine the priority of invention. A lengthy interference proceeding ensued, but the Patent Office Board of Interferences found that Sweet did not disclose a function generator and hence could not claim it in combination with his drop-writing apparatus.

89. The Board of Interferences, in rendering the decision, adopted the position taken by Lewis and Brown relative to the scope of the Sweet application as follows:

> Sweet's system records a cursive line representative of the voltage of an unknown, incoming waveform. A "picture" of the waveform appears on a moving strip of paper . . . It writes a continuous line, a cursive line, the length depending upon the length of the incoming signal.

J. *Sweet and Cummings Work and Patent; Mead's Interest*

90. While Sweet and his supervisor Cumming were still working under the Signal Corps contract, they jointly conceived an ink-jet printer utilizing an array of jets arranged side by side in tandem.

91. The Sweet and Cumming device included two embodiments. The first, conceived on May 20, 1963, was for a facsimile recorder in which the input signal to the charging electrodes of the device would produce the desired image, such as a television video signal. That machine was not capable of printing predetermined characters, but could only print characters represented by the original signal fed to it.

92. A second embodiment of the Sweet and Cumming device was conceived later, on September 12, 1963. That machine included a character generator which enabled the Sweet-Cumming device to print predetermined characters.

93. Sweet and Cumming proposed that Stanford's laboratory undertake development of their idea. Stanford's laboratory director, however, rejected it.

94. Like the Sweet application filed earlier, the application covering the Sweet and Cumming device was filed by Honeywell, acting on behalf of Sweet and Cumming. The first Sweet-Cumming application was filed on March 25, 1964, as Serial No. 354–

721; it was later supplanted by continuation-in-part application No. 660,163, filed August 1, 1967. As issued, the Sweet-Cumming patent (No. 3,373,437) disclosed both embodiments conceived by Sweet and Cumming in May and September of 1963, respectively. Neither of them was ever actually built by either Sweet and Cumming or by Stanford.

95. On the face of their patent, Sweet and Cumming acknowledged an indebtedness to Sweet's prior work stating:

> "The present apparatus and method makes use of the invention disclosed in said copending application S.N. 354,659, particularly in that fluid droplets from a jet nozzle are electrostatically deflected in accordance with signal values by electrostatically charging the droplets in accordance with instantaneous signal values and then causing the charged droplets to be deflected by passing them through a substantially constant electrostatic field, the droplets being either deposited on a record medium or deflected to droplet intercepting means."

96. However, the ink jet devices of Sweet and of Sweet and Cumming achieve different results. In Sweet, one is attempting to replicate on paper the incoming waveform using a single jet; in Sweet and Cumming, the multiple jets in combination do not replicate on paper the incoming sig-

nal or waveform, but rather create visual information which is not characteristic of the waveform.

97. The Sweet and Sweet and Cumming devices also operate in a different way and utilize a different combination of parts. Where Sweet utilizes a single nozzle with deflection of the variously charged droplets laterally with respect to the relative movement of the paper and nozzle so as to replicate on paper the incoming waveform, Sweet and Cumming utilize two levels of charge and the cooperation of closely spaced jets to convey information. In Sweet and Cumming, uncharged drops which are used for printing pass through the deflection field undeflected to mark the paper, and the droplets which are charged are deflected to a catcher and prevented from reaching the paper. In Sweet and Cumming, deflection of those droplets to the catcher is longitudinal with respect to the relative movement of the paper and nozzle, and the catcher is parallel to the row of jets and extends across the pages.

98. The Sweet and Cumming printing system is not the equivalent of the Sweet oscillograph. Although the Sweet and Cumming printer uses some of the scientific principles involved in Sweet's oscillograph (which Sweet and Cumming described in their patent as Sweet's "invention"), Sweet himself stated:

The concepts in our facsimile and printing ideas are not applicable to oscillographic recording systems. They do, however, involve ink jets with drop formation and electrostatic charging processes similar to those used in my oscillograph. The situation seems analagous to the case of microwave vacuum tubes which differ widely in configuration and application, but which have similar electron guns.

99. A. B. Dick and Mead now jointly own the Sweet-Cumming patent, A. B. Dick having purchased Sweet's interest and Mead having purchased Cumming's interest.

100. Mead began its development effort in ink jet printing, which culminated in the development of the DIJIT printer (the accused device), in earnest, in April, 1967, with the assistance of personnel of Battelle Memorial Institute in Columbus, Ohio.

101. Mead's efforts toward an ink jet printing system involved placement of a multitude of ink drops on a page to form a visually perceptible image of something other than a waveform. Mead envisioned an array of orifices across a page, or other printing surface, from which ink droplets would issue at high rates of speed as the page moved past the array. Selective interception of droplets which are not desired to mark the page to form the image would be effected by a switching operation in which each droplet not to be recorded would be

electrically charged and deflected to an ink catcher.

102. Shortly after the issuance of the Sweet-Cumming patent in March, 1968, Mead began the negotiations which resulted in its purchase of Dr. Cumming's interest in that patent. Mead became interested in the Sweet-Cumming patent because it involved the concept under development by Mead wherein an array of orifices forming ink jets are utilized to print alpha-numerics and graphics by selectively intercepting droplets to form an image.

K. *The Mead DIJIT Printer*

103. The Mead DIJIT printer utilizes a multiple array concept for printing in which the droplets used for printing issue simultaneously from a plurality of orifices. The droplets which print are essentially uncharged and undeflected in the Mead system. The DIJIT printer has a printhead disposed above and extended across the paper to be printed. This printhead includes an ink manifold and an orifice place which contains about 100–120 orifices per inch from which ink jets issue. A piezoelectric stimulating element is in physical contact with the orifice plate to vibrate the plate and to cause ink issuing from each jet to form a succession of uniformly sized and uniformly spaced ink droplets. Each orifice of the multiple array of orifices is thereby capable of producing ink drops at a rate of about 50,000 per second.

104. In the DIJIT printer, each droplet issuing from each orifice passes a charging electrode located in a charge tunnel positioned below the orifice plate. There an electric voltage charges each droplet to a standard charge value to effect interception unless a computer commands the absence of such voltage and grounds the charging electrode to avoid all but a minimal charge on the droplet. The droplets emerging from the charge tunnels then pass between a catcher and a deflection ribbon which are disposed below and on either side of the array of orifices. The catcher and deflection ribbon are maintained at a constant electrostatic potential. This arrangement of the catcher and deflection ribbon creates an electrostatic field. The droplets emerging from the orifices which have been charged to the standard charge value as they pass through the charge tunnel are deflected by the electrostatic field to the catcher, and thus do not mark the paper. The droplets which are not so charged to the standard value fall between the catcher and the deflection ribbon and mark the printing paper.

105. Each intercepted droplet in the DIJIT printer is deflected to a catch position in a substantially longitudinal direction with respect to the relative movement between the paper and the printhead. The DIJIT printer cannot operate if droplets deflect in a direction transverse of the rela-

tive movement between the paper and the printhead. The DIJIT printer provides no means for accomplishing such deflection.

106. In one sense, a single orifice on the Mead DIJIT is capable of producing one waveform. A single orifice operating without signal disturbance traces a line characteristic of the lack of disturbance. A line is a waveform. Moreover, a single orifice is capable of producing a linear waveform with periodic discontinuities. However, each orifice is incapable of producing a continuous waveform characteristic of a variable signal, and each orifice is incapable of producing common alphanumeric or geometric configurations.

107. The DIJIT printer achieves its desired function only through the combined results of the multiple orifices acting in cooperation with each other. Each single jet alone achieves no useful result. The DIJIT printer does not seek to trace on paper the incoming signal to a charge tunnel or tunnels; rather, the ink droplets, through the collective arrangement of the orifices and coordinated interception of droplets, create a composite picture unlike the incoming signals. The final picture is alphanumeric or graphic information which is not characteristic of the charging signals to the charging tunnels.

108. This concept of printing by directing a multitude of ink droplets toward a page, and selectively intercepting some of

the droplets to form the image on the page, has been embodied in every commercialized Mead ink jet printing system.

L. *The Events Leading up to this Litigation*

109. Ten days after the issuance of the Sweet patent on August 6, 1971, A.B. Dick notified Mead that application of the Sweet and Cumming array technology in connection with Mead's ink jet activities would infringe the Sweet patent.

110. Mead responded on August 17, 1971, stating that its plans for commercial activities in the "ink-jet printing area are not yet firm" but that, in any event, Mead did not believe activities based on the Sweet and Cumming array technology would infringe the Sweet patent.

111. Nothing more was heard from A. B. Dick about the Sweet patent until April, 1972, when A. B. Dick contacted Mead by telephone again asserting A. B. Dick's position that Mead could not practice the technology of Sweet and Cumming in its activities with respect to the Mead DIJIT ink jet printer without infringing the Sweet patent. By letter of May 5, 1972, Mead promptly replied to A. B. Dick setting forth in detail the noninfringement position of Mead, including a detailed discussion of the differences between the Sweet oscillographic apparatus and method and the binary, on-off operation of the Mead DIJIT system.

112. After May, 1972, between several extended delays, the parties periodically exchanged correspondence and met to discuss the same matter.

113. In September, 1973, the commercial Mead DIJIT printer won the IR 100 award of Industrial Research Magazine recognizing the 100 most significant commercial developments of the year.

114. In the same year, Mead began to sell printing service using a DIJIT system prototype.

115. Mead first offered a DIJIT printer for sale in 1975.

116. Mead's DIJIT system proved unprofitable through 1975 or 1976. By the middle of 1974, Mead had spent about six million dollars in research and development on DIJIT; the budget for 1974 was one million six hundred thousand dollars. The current budget generally runs to ten million dollars. Mead employs some 285 employees in the Dayton area in connection with the Mead's ink jet printing systems.

117. A. B. Dick commenced its suit against Mead on June 8, 1978. Between 1975 and 1978, Mead had contemplated but abandoned the idea of acquiring A. B. Dick. A. B. Dick's property interest in the Sweet, Lewis-Brown and Sweet-Cumming patents were considered by Mead when deciding whether to acquire A. B. Dick.

M. *Findings on Specific Issues*

1. *Laches*

118. A. B. Dick first became aware of the possibility that Mead might infringe on the Sweet patent approximately six years and ten months before it commenced infringement litigation. However, at the time of A. B. Dick's first awareness, the activities by Mead which A. B. Dick thought might infringe were "not yet firm."

119. A. B. Dick was apprised of Mead's position that DIJIT's development would not infringe on the Sweet patent, and an extensive articulation of Mead's reasons, therefor, approximately six years and one month before it commenced infringement litigation.

120. Mead's first commercial utilization of a prototype DIJIT system occurred approximately five years and six months before A. B. Dick commenced infringement litigation. Mead's utilization at this time was quite limited and unprofitable.

121. The prospect of profit by Mead in commercial utilization of the DIJIT system did not materialize until around 1975, approximately three years before A. B. Dick commenced infringement litigation.

122. Mead's contemplated acquisition of A. B. Dick after 1975 provides no reasonable excuse for A. B. Dick's failure to commence infringement litigation before 1978.

However, given the initial uncertainty of Mead's plans in the ink-jet printing field, and given the uncertain commercial future of the DIJIT system during much of the time preceding 1978, it cannot be said that A. B. Dick's delay in filing suit, of as much as six years and ten months, was, under the circumstances, unreasonable.

2. *DIJIT's Infringement of Sweet*

123. Each orifice in the DIJIT printer, and, as a result, the DIJIT system as a whole, *literally infringe* claim 1 or claim 33 of the Sweet patent, *if* "lateral" deflection in claim 1 is interpreted to include deflection *longitudinal* of the relative movement between the record member and the nozzle, *or* if deflection in multiple "trajectories" to multiple "regions" in claim 33 is interpreted to include deflection in that same direction.

124. Each orifice in the DIJIT printer *does not literally infringe* claim 1 or claim 33 of the Sweet patent *if* said claims are interpreted to describe *only* deflection transverse of the time-axis of relative movement between the record member and nozzle, and thus define only oscillography.

125. If the DIJIT printer does not literally infringe claim 1 or claim 33 of the Sweet patent, as interpreted in the preceding paragraph, it does not infringe as an equivalent of the Sweet invention as claimed. Each orifice in the DIJIT printer, as well as the combined operation of the

array of orifices in the DIJIT printhead, do not perform substantially the same function in substantially the same manner to produce substantially the same result as claimed in the Sweet invention.

3. *DIJIT's Infringement of Lewis-Brown*

126. The DIJIT printer does not literally infringe claim 2 of the Lewis-Brown patent, or infringe same as an equivalent of the invention claimed, therein. No single orifice in the DIJIT printer produces multiple "characters" or is capable of producing multiple "characters" as the term is defined in the Lewis-Brown patent. Each orifice in the DIJIT printer, as well as the combined operation of the array of orifices in the DIJIT printhead, do not perform substantially the same function in substantially the same manner to produce substantially the same result as claimed in the Lewis-Brown invention.

4. *Matters Related to the Validity of the Sweet Patent*

127. The Sweet patent and neither of the applications, therefor, made disclosure regarding the specific properties of the ink to be used in Sweet's device, or regarding the use of a compensation network for drop placement error.

128. Sweet believed that the properties of the ink to be used were critical to the device's proper operation, but he also found

that every ink which he had used, which could be passed through the nozzle, worked well.

129. There is no evidence that Sweet contemplated a specific ink or writing fluid with specific properties which would result in a best mode of operation at any time during the prosecution of his patent. Sweet's failure to disclose specific properties of ink critical to proper operation of the device does not constitute failure to disclose the best mode contemplated by him for practicing his invention.

130. Sweet testified that he had used a compensation network in connection with his "best system." Sweet did not state whether he thought that the compensation network was essential to the "best system." On the contrary, because the compensation network only corrected drop placement when the signal voltage varied substantially in a short period of time, Sweet thought that the network "usually" was not necessary.

131. It is unclear whether the compensation network was contemplated by Sweet as a necessary part of the best mode for practicing his invention or whether, on the other hand, the network was thought an advantageous means for practicing his invention under limited circumstances but, cost and other factors considered, was not necessarily advantageous under ordinary circum-

stances. Sweet's failure to disclose the use of a compensation network in conjunction with the operation of his device does not constitute failure to disclose the best mode contemplated by him for practicing his invention.

132. Sweet did not disclose the use of a catcher for intercepting droplets, as an intensity control, in the first patent application, filed on July 31, 1963. Disclosure of a catcher in the practice of his invention was made in the second patent application, filed on March 25, 1964, and was included in the patent as issued.

133. Sweet contemplated the use of a catcher "very early" in the development of his invention and had conducted experiments using a catcher prior to his first patent application. However, Sweet testified that at the time the first patent application was filed, the catcher "was still very experimental in that I had just completed it and had really had no chance to assess its practicality or its reliability." At the time of the first application, Sweet was not certain that the catcher was a necessary part of the best mode of practicing his invention "in light of its complexity." Sweet's failure to disclose the use of the catcher in the operation of his device in his first patent application, filed on July 31, 1963, does not constitute a failure to disclose the best mode contemplated by Sweet for practicing his invention at that time.

134. Because Sweet did not fail to disclose the best mode contemplated by him for practicing his invention in the first patent application filed on July 31, 1963, Sweet's patent is entitled to an effective filing date of July 31, 1963.

135. Because the effective filing date of the Sweet patent is July 31, 1963, potential public uses (e. g., during the August, 1962, TAC and Contractor meetings), potential placements on sale (e. g., by Sweet's letters after August, 1962), potential descriptions in printed publications (e. g., CQSRs 32 and 33, distributed some time prior to March, 1963), and other activities with respect to Sweet's invention after July 31, 1962, are not significant.

136. CQSR 31 contained an unclassified description of Sweet's invention. CQSR 31 was distributed, as a confidential document prior to July 31, 1962, to a select number of persons and organizations interested in the field of ink jet printing and related technologies.

137. Although the description of Sweet's invention in CQSR 31 was unclassified, it is not clear that its distribution to selected persons and organizations under confidential cover rendered the descriptions accessible to a substantial portion of the class of persons skilled or interested in the art of ink jet printing. CQSR 31 was not a printed publication. CQSR 31 does not constitute a description more than one year prior to the effective application date.

138. Sweet did not disclose Waage's work to the patent office during the prosecution of his patent applications. Although Sweet thought that Waage was the "closest prior art," at least by 1970, he thought this was so only in relation to the art of drop generation for purposes other than writing or recording.

139. Waage did not teach a recording use for his device. Moreover, Waage did not teach variable deflection of selectively charged droplets in a constant or uniform deflection field. To the extent that Waage did disclose deflection for purposes of observing the physics of drop movement, Waage was more remote, or cumulative to other prior art references ultimately known to the patent office prior to the issuance of the Sweet patent, such as Magarvey's studies.

140. Sweet's failure to disclose Waage's work to the patent office during the prosecution of his patent applications did not violate the duty of candor to the patent office.

141. None of Mead's prior art references disclose a device for permanently recording variable electronic signals by constant field deflection of selectively charged discrete ink droplets projected toward a recording medium. A device such as this was not known in the art prior to Sweet's work.

142. The fact that the basic elements of such device had been known in the art for

at least 30 years prior to Sweet's work (i. e., Rayleigh's study of drop formation phenomenon in conjunction with Schroter's disclosure of a variably charged ink jet for recording purposes), but that the device had not been reduced to practice until Sweet's work, is indicative that such a device was not obvious to a person of ordinary skill in the art prior to Sweet's work. Magarvey's repeated disclosures of a discrete droplet charge system beginning more than five years before Sweet's work, and the absence of a recording purpose for same until Sweet's work, lends support to this conclusion.

143. Sweet's patent claims invention of means for practicing one of the number of devices for the purpose of oscillographic recording. As such, the claimed invention was not known in the art prior to Sweet's work, and would not have been obvious to a person of ordinary skill in the art prior to that time.

5. *Matters Relating to the Validity of the Lewis-Brown Patent*

144. Sweet's use of a sine-wave generator in conjunction with the practice of his invention was disclosed to the patent office in the course of Lewis' and Brown's prosecution of their patent applications. Lewis and Brown did not violate the duty of candor to the patent office in this respect.

145. The Lewis-Brown patent defines "character" or "characters" to include waveforms. This definition, in conjunction with claim 2 of the Lewis-Brown patent, defines Sweet's prior work using a sine-wave generator in conjunction with his oscillographic recorder, with the exception of possible minor improvement in the type of transducer applied to stimulate drop formation. Lewis and Brown did not invent the use of Sweet's device in conjunction with a sine-wave generator.

146. Sweet did not use a catcher to effect discontinuous drop placement, and did not practice his invention to produce discontinuous characters as otherwise defined in the Lewis-Brown patent (i. e., alphanumerics and geometric configurations). The art prior to Lewis and Brown discloses no device employing Sweet's invention in conjunction with an alphanumeric or geometric character generator to produce alphanumeric or geometric characters.

147. However, the use of character generators other than sine-wave generators, in connection with ink drop printing, was known in the art prior to Lewis' and Brown's work. For example, the Winston patent, which was employed commercially as the Teletype Inktronic, discloses the application of a "control device" to "character-delineating electrodes" in order to produce a "predetermined pattern." Moreover, the Lewis-Brown patent in itself states:

Appendix A

The technique of providing sets of digital pulses which are characteristic of predetermined characters is well-known to those familiar with the art, and therefore need not be described in detail.

148. That the use of character generators other than sine-wave generators in connection with ink drop printing was known in the art prior to Lewis' and Brown's work; that Sweet had used a sine-wave generator, which is a kind of character generator, in conjunction with his invention; and that Lewis and Brown reduced to practice the use of a character generator, other than a sine-wave generator in connection with Sweet's invention within the year after learning of Sweet's work, are all indicative that the use of a character generator, other than a sine-wave generator in connection with Sweet's invention, would have been obvious to a person of ordinary skill in the art at the time of Lewis' and Brown's work.

IV.

Conclusions of Law

A. *Laches*

[5, 6] 149. A defendant in an infringement suit who asserts the defense of laches has the burden of proving an unreasonable delay by the plaintiff in filing suit after the first notice of infringement. However, the defendant is aided in carrying this burden

by a presumption which is derived from the statutory period of recoverable damages found in 35 U.S.C. § 286. The presumption holds that a delay in filing suit longer than six years after the notice of infringement is unreasonable and prejudicial. Under such circumstances, the plaintiff will be barred by laches unless he can: (1) rebut the presumption of unreasonableness in the delay by showing a good excuse, therefor; (2) rebut the presumption of prejudice; or (3) show such egregious conduct on the defendants' part that the equities otherwise weigh in plaintiffs' favor. *TWM Mfg. Co. v. Dura Corp.*, 592 F.2d 346, 348–49 (6th Cir. 1979).

[7] 150. As indicated above (para. 122), the Court is satisfied that Mead's own initially uncertain plans in development of the DIJIT printer, and the commercial uncertainty of DIJIT for an extended period thereafter, are sufficient findings upon which to base a conclusion that A. B. Dick's delay in filing suit, in excess of six years, was not unreasonable as a matter of fact under the circumstances. A. B. Dick is, therefore, not precluded from prosecuting this infringement action by reason of laches.

B. *The Infringement Issues*

151.

In determining whether an accused device or composition infringes a valid pat-

ent, resort must be had in the first instance to the words of the claim. If accused matter falls *clearly* within the claim, infringement is made out and that is the end of it.

Graver Tank & Mfg. Co. v. Linde Air Products, 339 U.S. 605, 607, 70 S.Ct. 854, 855, 94 L.Ed. 1097 (1950) (emphasis added).

[8, 9] 152. However, where the claims in a patent are ambiguous, the claims "must be read in the light of the invention disclosed and cannot be given a construction broader than the teachings of the patent as shown by the drawings and specification." *FMC Corp. v. F. E. Myers & Bros. Co.*, 384 F.2d 4, 13 (6th Cir. 1967); *United States v. Adams*, 383 U.S. 39, 49, 86 S.Ct. 708, 713, 15 L.Ed.2d 572 (1966); *Schriber-Schroth Co. v. Cleveland Trust Co.*, 311 U.S. 211, 217, 61 S.Ct. 235, 238, 85 L.Ed. 132 (1940). Since the Sweet patent discloses only oscillographic recording, the scope of its claims is limited to oscillographic recording. The Lewis and Brown patent claims are limited in scope to the only operation disclosed which requires printing of characters with charged droplets that are deflected transverse to the relative movement between the paper and nozzle.

[10] 153. Based on representations made to the Patent Office and amendments made to the claims in order to obtain the patent, A. B. Dick is estopped to construe the claims of the Sweet patent to claim other than an oscillographic recorder. *Kai-*

ser Industries Corp. v. McLouth Steel Corp., 400 F.2d 36 (6th Cir. 1968), *cert. denied*, 393 U.S. 1119, 89 S.Ct. 992, 22 L.Ed.2d 124 (1969). A "patent must be judged by what is claimed for it in the patent application—not by what is asserted in subsequent litigation." *Philips Industries v. State Stove & Mfg. Co.*, 522 F.2d 1137, 1140 (6th Cir. 1975), citing *Ohio Citizens Trust Co. v. Lear Jet Corp.*, 403 F.2d 956, 958 (10th Cir. 1968), *cert. denied*, 394 U.S. 960, 89 S.Ct. 1308, 22 L.Ed.2d 561 (1969).

[11, 12] 154. The DIJIT printer does not literally infringe on claims 1 or 33 of the Sweet patent or on claim 2 of the Lewis-Brown patent, as said claims are properly interpreted.

[13] 155. An accused device may be found to infringe on a patent, if not literally, as an equivalent of the claimed invention if the accused device "performs substantially the same function in substantially the same way to obtain the same result." *Graver, supra*, at 608, 70 S.Ct. at 856.

156. Mead's DIJIT printer does not infringe the Sweet patent because the DIJIT printer performs a function substantially different from that of the Sweet recording oscillograph and operates in a substantially different way to accomplish a substantially different result. Mead's DIJIT printer does not infringe the Lewis and Brown patent because the DIJIT printer performs a function substantially different from that of the

character printer disclosed in the Lewis and Brown patent and operates in a substantially different way to accomplish a substantially different result. *Dunlop Co. v. Kelsey-Hayes Co.*, 484 F.2d 407 (6th Cir. 1973), *cert. denied*, 415 U.S. 917, 94 S.Ct. 1414, 39 L.Ed.2d 471 (1975); *Nickerson v. Bearfoot Sole Co.*, 311 F.2d 858 (6th Cir. 1962), *cert. denied*, 375 U.S. 815, 84 S.Ct. 48, 11 L.Ed.2d 279 (1963).

C. *The Validity of the Sweet Patent*

157. The Sweet patent is not invalid for failure to disclose the best mode contemplated by Sweet for practicing his invention, under 35 U.S.C. § 112, by reason of Sweet's failure to disclose the properties of ink to be used in operation of his device, or the use of a compensation network in connection with the operation of his device.

158. July 31, 1963, is the effective filing date of Sweet's application for his patent, and said filing is not rendered ineffective for failure to disclose the best mode contemplated by Sweet for practicing his invention at that time, under 35 U.S.C. §§ 112, 120; by reason of Sweet's failure to disclose the use of a catcher in the operation of his device; the properties of ink to be used in the operation of his device; or the use of a compensation network in connection with the operation of his device.

159. The Sweet patent is not invalid, under 35 U.S.C. § 102(b), by reason of any activity in connection with Sweet's work within the year preceding July 31, 1963.

160. Because CQSR 31 is not a printed publication within the meaning of 35 U.S.C. § 102(b), the Sweet patent is not invalid under 35 U.S.C. § 102(b) by reason of the distribution of CQSR 31, containing a description of Sweet's invention, prior to July 31, 1962.

161. The Sweet patent is not invalid for violation of the duty of candor to the patent office, by reason of Sweet's failure to disclose the Waage reference to the patent office during the prosecution of his patent applications.

162. The Sweet patent is not invalid under 35 U.S.C. § 103 because the differences between the subject matter patented by Sweet and the prior art are such that subject matter taken as a whole would not have been obvious to a person having ordinary skill in the art at the time of Sweet's invention.

D. *The Validity of the Lewis-Brown Patent*

163. The Lewis-Brown patent is not invalid for violation of the duty of candor to the patent office, since Lewis and Brown did disclose Sweet's work with a sine-wave generator to the patent office during the prosecution of their patent applications.

[14] 164. A patent carries a statutory presumption of validity. 35 U.S.C. § 282. The presumption of validity gives the grant substance and value but is not conclusive. *Westinghouse Electric Corp. v. Formica Insulation Co.*, 266 U.S. 342, 348, 45 S.Ct. 117, 119, 69 L.Ed. 316 (1924). The presumption has no independent evidentiary value in infringement litigation but only serves to place the burden of proof on the party who asserts invalidity as a defense to infringement. *Reynolds Metals Co. v. Acorn Building Components, Inc.*, 548 F.2d 155, 160 (6th Cir. 1977).

165. The Lewis-Brown patent is invalid under 35 U.S.C. § 102(f), to the extent it claims invention of the use of a sine-wave generator in connection with the operation of Sweet's invention because Sweet, and not Lewis and Brown, invented the subject matter so described.

166. The Lewis-Brown patent is invalid under 35 U.S.C. § 103 because the differences between the subject matter sought to be patented by Lewis and Brown and the prior art are such that the subject matter taken as a whole would have been obvious to a person of ordinary skill in the art at the time Lewis' and Brown's invention was made.

WHEREFORE, based upon the foregoing, it is the opinion of this Court that:

(1) Plaintiffs are not precluded from prosecuting this infringement action by reason of laches;

(2) Mead's DIJIT printer does not infringe, literally or as an equivalent, on claims 1 and 33 of the Sweet patent or on claim 2 of the Lewis-Brown patent;

(3) The Sweet patent is valid; and

(4) The Lewis-Brown patent is invalid.

The Defendant Mead is to prepare a Judgment Entry, in accordance with the above opinion, and submit same to this Court for filing within twenty-one (21) days from date of receipt of this opinion.

APPENDIX B

In The

UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF OHIO

MEAD DIGITAL SYSTEMS, INC.,

Plaintiff,

v.

A. B. DICK COMPANY and GOULD, INC.,

Civil Action No. C-3-78-177

Defendants.

and

A. B. DICK COMPANY and GOULD, INC.,

Plaintiffs,

v.

THE MEAD CORPORATION,

Civil Action No. C-3-78-287

Defendant.

MEAD'S OPPOSITION
TO
MOTION FOR ENTRY OF FINAL JUDGMENT
IN FORM PROPOSED BY PLAINTIFFS

The judgment proposed by A. B. Dick and Gould is defective since it fails to provide a declaration of the legal scope of the patents in suit. Such relief was raised by Mead's action for declaratory judgment,

and was set forth by Mead as specific issues to be tried in the Final Pretrial Order (copies of the pertinent pages are attached).

The scope and meaning of the patents were major issues at trial, and were disputed rights determined by the Court.

Mead should not be subjected to relitigation of these same issues in the future, and is entitled to a declaration of these rights in the judgment.

If Mead was too editorial in its proposed judgment as alleged by Plaintiff, Mead apologizes and asks the Court to draft its own judgment declaring the legal scope of the patents, whether they be valid or invalid in their scope.

Respectfully submitted

/s/ Bill Durkee

Bill Durkee
Edward W. Goldstein
Ben D. Tobor
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Appendix B

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Appendix B

(7) Did the demonstrations by Sweet after August 1, 1962, amount to a public use or placing on sale within the meaning of 35 U.S.C. §102?

(8) Is the Sweet patent unenforceable and/or invalid because of failure of Sweet to disclose to the Patent Office prior art known to him as being pertinent?

(9) Are any or all of the claims of the Sweet patent invalid for being vague and indefinite and failing to point out and distinctly claim the subject matter set forth in the specification of said patent?

(10) What is the legal scope of the claims of the Sweet patent?

(11) Are any of the claims of the Sweet patent invalid or unenforceable for attempting to claim or for claiming subject matter invented by Sweet and Cumming or Lewis which is not disclosed in the

Appendix B

Sweet specification?

(12) Does the legal scope of the claims of the Sweet patent define patentable subject matter in view of prior art?

(13) Has the legal scope of the claims of the Sweet patent been infringed by any product of Mead?

(14) Is the Lewis patent unenforceable and/or invalid because of failure of Lewis to disclose to the Patent Office prior art known to him as being pertinent?

(15) Are any or all of the claims of the Lewis patent invalid for being vague and indefinite and failing to point out and distinctly claim the subject matter set forth in the specification of said patent?

(16) What is the legal scope of the claims of the Lewis patent?

(17) Does the legal scope of the claims of

the Lewis patent define patentable subject matter in view of prior art?

(18) Has the legal scope of the claims of the Lewis patent been infringed by any product of Mead?

(19) Did A.B. Dick waive its right to enforce the Sweet patent or the Lewis patent against Mead, either as to recovery for past damages or as to enforcing the patent in the future, by failing to bring an action against Mead and allowing Mead to continue investment in ink jet technology?

(20) Does Mead have the right to practice within the scope of the Sweet and Cumming patent without accounting to its joint owner A.B. Dick?

(21) Are the Sweet and Lewis patents unenforceable or subject to licensing at reasonable royalty rates because A.B. Dick acquired the Sweet and Lewis

patent rights from independent third parties and combined and concentrated the power of the two individual patent monopolies to gain unfair and

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APPENDIX C

In The
UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF OHIO

MEAD DIGITAL SYSTEMS, INC.,	)	
	)	
Plaintiff,	)	
v.	)	Civil
A. B. DICK COMPANY	)	Action No.
and GOULD, INC.,	)	C-3-78-177
	)	
Defendants.	)	
	)	
and	)	
	)	
A. B. DICK COMPANY	)	
and GOULD, INC.,	)	
	)	
Plaintiffs,	)	
	)	Civil
v.	)	Action No.
THE MEAD CORPORATION,	)	C-3-78-287
	)	
Defendant.	)	

MEMORANDUM IN REPLY TO MEAD'S OPPOSITION TO PLAINTIFF'S MOTION FOR ENTRY OF FINAL JUDGMENT IN FORM PROPOSED BY PLAINTIFFS

Mead's only criticism of the form of Final Judgment proposed by plaintiffs is that it fails, according to Mead, to provide "a declaration of the legal scope" of the patents in suit. Mead, the Court is told, "should not be subjected to re-litigation of the same issues in the future"--

i.e., the issues which were tried last November and recently decided.

Mead is perfectly correct in contending that the Final Judgment entered in this case should dispose, once for all, of the matters which were in controversy at the trial--specifically, whether the patents in suit are valid and whether they have been infringed by any of the apparatus that Mead, on the date of trial, had manufactured and sold. And a Final Judgment in the form proposed by plaintiffs will fully protect Mead's rights in that regard; it would adjudge (a) that the Sweet patent is valid, (b) that the Lewis-Brown patent is invalid, and (c) that neither patent has been infringed by any of the ink-jet printing equipment that Mead has sold. Thus, the Final Judgment proposed by plaintiffs fully and finally disposes of every issue that

was before the Court at the trial of this cause.

What Mead really wants--and is trying to secure by its own proposed form of Final Judgment--is an advisory opinion which would finally adjudge, without either trial or argument, that the Sweet patent--in addition to being not infringed by the Dijit machines--would also be not infringed by other ink-jet printing equipment that Mead may design and market in the future. For the Court to issue such an advisory opinion, on whether hypothetical ink-jet printers would fall within the scope of the Sweet patent, would violate the U.S. Constitution. The judicial power of Federal Courts is limited to resolving "real and substantial" controversies, "admitting of specific relief through a decree of a conclusive character, as distinguished from an opinion

advising what the law would be upon a hypothetical state of facts" (Aetna Life Insurance Co. v. Haworth (1937), 300 U.S. 227, 241). To the same effect, in a patent context, see Sweetheart Plastics Inc. v. Illinois Tool Works, Inc. (1st Cir., 1971), 439 F.2d 871, 874-875.

Only because it wants an advance immunity for its next generation of ink-jet printers is Mead asking this Court to adjudge the "legal scope" of the patents in suit. But this Court, under the U.S. Constitution, has no power to give Mead any such advance immunity.

Should Mead, in the future, develop and market a form of ink-jet printer different from the ones before the Court in this action, and should that new printer be accused of infringement, then a brand-new "case or controversy" would be created,

which this or some other Court could properly resolve by a new trial. But no such determination can be made in this case.

It is true that Mead, in the Pretrial Order, raised an issue as to what was the "legal scope" of the patents in suit, but plaintiffs never conceded that any such issue was involved. The only questions of infringement before the Court are those presented by the Mead Dijit machines, and the Court can only pass on the "legal scope" of the patents to the extent required for resolution of those questions.

Mead's proposed form of Final Judgment should be rejected and the one tendered by plaintiffs should be entered.

Respectfully submitted,

/s/ Howard P. Krisher

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Appendix C

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APPENDIX D

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF OHIO
200 West Second Street
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Chambers of
Walter H. Rice
District Judge

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January 25, 1982

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Re: Mead Digital Systems v. A.B. Dick Company, et al. A.B. Dick Company,

Appendix D

et al. v. The Mead Corporation
Case Nos. C-3-78-177 and C-3-78-287

Gentlemen:

Herein please find the too-long delayed Final Judgment Entry in the captioned cases.

I have utilized the form of proposed Judgment Entry furnished by Mead, with one exception, to wit: in paragraph numbered 3, I have deleted the words "as so construed". Perhaps I am missing that which is as obvious as the nose on my face, but I simply do not feel that those words add anything to the overall finding. In other words, I have construed the scope of the Sweet patent in paragraph numbered 2. Obviously, it is an inference from such a finding that the patent is valid as so construed. I simply see no reason to express that which is quite obviously inferred.

Sincerely,

/s/ W. Rice

WALTER H. Rice

WHR:slc

Enclosure

APPENDIX E

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF OHIO
WESTERN DIVISION

MEAD DIGITAL SYSTEMS, INC.	:	
Plaintiff,	:	
vs.	:	Case No. C-3-78-177
A.B. Dick Company and GOULD, INC.,	:	
Defendants.	:	
and	:	
A.B. DICK COMPANY and GOULD, INC.,	:	
Plaintiffs,	:	
vs.	:	Case No. C-3-78-287
THE MEAD CORPORATION,	:	
Defendant.	:	

FINAL JUDGMENT

These actions came on for trial before the Court, Honorable Walter H. Rice, District Judge, presiding, and the issues having been duly tried and a decision having been duly rendered,

Appendix E

It is Ordered, Adjudged, and Declared:

1. Mead's Dijit printer does not infringe Sweet Patent No. 3,596,275.

2. The Sweet Patent is limited in scope to oscillographic recording.

3. The Sweet patent is valid.

4. Mead's Dijit printer does not infringe Lewis-Brown Patent No. 3,298,030.

5. The Lewis-Brown patent is limited in scope to printing of characters with charged droplets that are deflected transverse to the relative movement between the paper and nozzle.

6. The Lewis-Brown patent is invalid.

7. A.B.Dick and Gould are not precluded from prosecuting the patent infringement action by reason of laches.

8. A.B. Dick and Gould shall take nothing, and the patent infringement actions by their complaint and counterclaim are dismissed on the merits.

Appendix E

9. The Mead Corporation and Mead Digital Systems shall recover of A.B. Dick and Gould their costs of the actions.

Dated at Dayton, Ohio, this 26th day of January, 1982.

/s/ Walter H. Rice
WALTER H. RICE
UNITED STATES DISTRICT JUDGE

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APPENDIX F

A.B. DICK COMPANY and Gould, Inc., Plaintiffs,

v.

BURROUGHS CORPORATION, Defendant.

No. 78 C 75.

United States District Court, N.D. Illinois, E.D.

Oct. 29, 1982.

On Counterclaims Nov. 5, 1982.

Upon defendant's motion for summary judgment in suit alleging patent infringement, the District Court, Shadur, J., held that: (1) decision of District Court for Southern District of Ohio upholding validity of patent on an oscillographic ink-jet printing device but construing its claims narrowly collaterally estopped plaintiff from claiming in instant suit that its patent was broader in scope than the Ohio court had found, and (2) patent No. 3,596,275 on an oscillographic ink-jet printing device was not infringed.

Motion granted.

Appendix F

1. Patents ⇐327(13)

Decision of District Court for Southern District of Ohio upholding validity of patent on an oscillographic ink-jet printing device but construing its claims narrowly collaterally estopped plaintiff in the action from claiming that its patent was broader in scope than the Ohio court had found.

2. Judgment ⇐634

Four showings necessary for invocation of defensive collateral estoppel by nonparty to earlier action are: (1) issue must be identical to one determined in the first action; (2) that issue must have been actually litigated in the first action; (3) resolution of issue must have been essential to final judgment in first action; and (4) plaintiff must have had a full and fair opportunity to litigate the issue in the first action.

3. Patents ⇐234

Patent No. 3,596,275 on an oscillographic ink-jet printing device was not infringed.

Dugald S. McDougall and Keith V. Rockey, McDougall, Hersh & Scott, Chicago, Ill., for plaintiffs.

L. Michael Jarvis, Allegretti, Newitt, Witcoff & McAndrews, Chicago, Ill., for defendant.

Appendix F

MEMORANDUM OPINION AND ORDER

SHADUR, District Judge.

A.B. Dick Company ("A.B. Dick") sues Burroughs Corporation ("Burroughs"), claiming Burroughs' ink-jet printer infringes United States Patent No. 3,596,275 (the "Sweet patent").[1] Burroughs has now moved for summary judgment, claiming the collateral estoppel effect of a recent District Court opinion precludes any finding of infringement here. For the reasons stated in this memorandum opinion and order, Burroughs' motion is granted.

A.B. Dick-Mead Litigation

Shortly after this action was instituted, the same plaintiffs sued The Mead Corporation ("Mead"), claiming Mead's ink-jet printer infringed both the Sweet and Lewis-Brown patents. Mead's subsidiary in turn filed a declaratory judgment action in the Southern District of Ohio, challenging both validity and infringement. Both Mead actions were consolidated and tried before

1. A.B. Dick owns the Sweet patent. Initially the Complaint also charged infringement of United States Patent No. 3,298,030 (the "Lewis-Brown patent"), owned by co-plaintiff Gould, Inc. and licensed exclusively to A.B. Dick. However, the parties have stipulated to dismissal of the Lewis-Brown infringement claims with prejudice, but subject to reinstatement if Judge Rice's ruling as to invalidity of that patent, *Mead Digital Systems, Inc. v. A.B. Dick Co.*, 521 F.Supp. 164, 182–83, 185 (S.D.Ohio 1981), is reversed or vacated on appeal.

District Judge Walter Rice in Ohio. Though he upheld the Sweet patent's validity, he construed its claims narrowly and hence found no infringement by Mead. *Mead Digital Systems, Inc. v. A.B. Dick Co.*, 521 F.Supp. 164 (S.D.Ohio 1981).

Burroughs contends Judge Rice's findings as to the scope of the Sweet patent call for collateral estoppel treatment and, as a matter of law, require rejection of A.B. Dick's infringement charges. A.B. Dick disputes Burroughs on every level, forcing a careful analysis of the relevant portion of *Mead*.

Scope of the Sweet Patent Under Mead

In deciding *Mead* Judge Rice defined the scope of the Sweet patent narrowly. He found that patent disclosed only an *oscillographic*[2] ink-jet printing device, which could directly record on paper the *waveform* produced by a continuously varying electrical signal. 521 F.Supp. at 173. He defined a waveform as "the pictorial repre-

2. Judge Rice adopted the definition of "oscillograph" contained in the McGraw-Hill Encyclopedia of Science and Technology:

> A measurement device for determining waveform by recording the instantaneous values of a quantity such as voltage, as a function of time. It consists of three major components: (1) a primary detector for sensing the instantaneous values of the quantity, (2) the timing system for introducing a time scale on the record, and (3) some means for recording the waveform.

sentation of the form or shape of a wave *with respect to time*" (*id.*, emphasis added). He described the recording process of the Sweet patent in greater detail (*id.*):

> The waveform is recorded, in accordance with the Sweet patent disclosures, by the imprint of uncharged and variably charged ink droplets on various positions on a paper. In every embodiment disclosed in the Sweet patent, the waveform of a continuously varying signal is recorded by a process which involves: charging each ink droplet in a succession of droplets in proportion to the instantaneous value, including zero, of an electric signal which varies as a function of time; and then passing the variably charged droplets through [a pair of constantly charged deflecting plates] to deflect the droplets through variable trajectories in order to produce on the paper a trace of the incoming waveform.[3]

There can be no doubt of the fundamental limitation of the Sweet patent adjudicated in *Mead*. As Judge Rice further found (*id.* at 175):

3. Each droplet's deflection (and the height of its trajectory) is a positive function of the magnitude of the charge it receives. Thus the amount of charge applied to each ink droplet—the "signal" voltage—dictates where it will land on the paper. Consequently any waveform can be reproduced on the paper simply by manipulating the electrical charges imposed on the procession of ink droplets.

> Sweet limited his invention to oscillography in which a picture of the incoming waveform is reproduced on paper by recording as a function of time the magnitude of deflection of each droplet in a succession so that the succession of deflected droplets traces the waveform on paper. This is the function and operation of an oscillograph.

He pointed to a like determination by the Board of Patent Interferences in a Patent Office interference proceeding between Sweet and Lewis-Brown (*id.* at 177):

> Sweet's system records a cursive line representative of the voltage of an unknown, incoming waveform. A "picture" of the waveform appears on a moving strip of paper.... It writes a continuous line, a cursive line, the length depending upon the length of the incoming signal.

And he held file wrapper estoppel precluded A.B. Dick from construing the Sweet patent claims to claim other than an oscillographic recorder (*id.* at 184).

Collateral Estoppel Effect of Mead's Determination of Scope

[1] *Blonder-Tongue Laboratories, Inc. v. University of Illinois Foundation,* 402 U.S. 313, 91 S.Ct. 1434, 28 L.Ed.2d 788 (1971) announced the demise of "mutuality" as an invariable prerequisite for issue preclusion (more commonly "collateral estoppel"). That concept of the defensive use of collateral estoppel has since expanded far beyond

its original application (*Blonder-Tongue* gave collateral estoppel effect to a prior holding of patent invalidity against the same plaintiff).[4]

[2] Now only four showings are necessary for the invocation of defensive collateral estoppel—issue preclusion—by a nonparty to the earlier action:

1. The issue must be identical to one determined in the first action.

2. That issue must have been actually litigated in the first action.

3. Resolution of the issue must have been essential to a final judgment in the first action.

4. Plaintiff must have had a full and fair opportunity to litigate the issue in the first action.

Continental Can Co. v. Marshall, 603 F.2d 590, 594–95 (7th Cir.1979); *Restatement of Judgments (Second)* § 29, at 291.

Burroughs contends Judge Rice's determination confining the Sweet patent to oscillographic recording should be given collateral estoppel effect. A.B. Dick counters that the first three collateral estoppel criteria have not been met.

Burroughs is plainly right. *Mead*'s ruling as to the scope of the Sweet patent

4. Indeed the Supreme Court later pioneered the extension of non-mutuality to the offensive use of collateral estoppel. *Parklane Hosiery Co. v. Shore*, 439 U.S. 322, 99 S.Ct. 645, 58 L.Ed.2d 552 (1979).

satisfies the first three collateral estoppel requirements (no issue is of course raised as to the "full and fair opportunity to litigate"):

1. Unquestionably the issue raised here—whether the Sweet patent is limited to oscillographic recording—is identical to an issue resolved in *Mead*. As already stated, Judge Rice expressly found (521 F.Supp. at 173) the "Sweet patent discloses only an oscillographic device." [5]

2. It is equally clear the scope of the Sweet patent was vigorously contested in *Mead*. That issue was specifically raised in the *Mead* Final Pretrial Order at 6. Extracts from the testimony of Sweet himself (521 F.Supp. at 173) confirm the issue was in fact raised during the trial. And Judge Rice rejected an A.B. Dick-tendered final order omitting a determination of scope in favor of a Mead-ten-

5. A.B. Dick does not attempt to distinguish that determination from issues presented here. Instead it argues (Pl.Mem. 15):

> Judge Rice's findings that Mead did not infringe because ink deflection was longitudinal of the relative movement between the paper and the nozzle is simply a different infringement issue than that presented by the Burroughs printer.

That contention is simply not responsive to the "identity of issue" requirement, for collateral estoppel is being applied to a determination of *scope* rather than *infringement*. Insofar as A.B. Dick's argument bears on the "necessity" requirement, it will be disposed of later in this opinion.

dered order making such a determination. A.B. Dick's conclusory assertion that the issue was not actually litigated cannot overcome those facts.

3. *Mead*'s resolution of the issue of scope (embodied in the final judgment itself) was surely necessary to that judgment. Because that ingredient is the key to this opinion (for it is the only matter on which A.B. Dick has any arguable position at all), it merits somewhat more extended treatment in the next few paragraphs.

First, Judge Rice's declaration was directly responsive to one form of relief requested by Mead in its declaratory judgment action (which, as will be recalled, was consolidated with A.B. Dick's patent infringement suit). Mead had specifically sought a declaration as to the scope and meaning of the Sweet patent.

Second, Judge Rice's ruling on the scope of the Sweet patent claims was an integral step in his disposition of the infringement claim:

1. As already indicated, he first determined the Sweet patent teaches only an oscillographic device.

2. Next he identified two specific characteristics of an oscillographic recorder:

(a) Its nozzle can produce a continuous waveform represented by a variable signal.

(b) It cannot deflect droplets longitudinally to the direction of paper movement.

3. Finally he deduced Mead was not guilty of infringement because its printer lacked both these oscillographic attributes.

Thus Judge Rice's first ruling—as to scope—was essential to his ultimate finding of non-infringement.[6]

In sum, Judge Rice's determination that the Sweet patent is limited to oscillography satisfies all the preconditions for collateral estoppel treatment in this proceeding. It remains only to consider whether the Burroughs printer too is oscillographic.

6. More precisely, Judge Rice's determination of the oscillographic nature of the Sweet patent was critical to his finding the Mead printer did not infringe as a substantial equivalent of the Sweet invention. To resolve that question he obviously had to determine (1) the functions served by the Sweet patented device and (2) the manner in which those functions were carried out. 521 F.Supp. at 180–81. By construing the Sweet patent claims as limited to oscillography, Judge Rice accomplished both ends.

Appendix F

Summary Judgment in Light of Mead

1. *Description of the Burroughs Printer*

[3] There is no factual disagreement as to how the Burroughs equipment operates. It is designed for printing characters on checks or similar documents in the manner explained in Dr. Richard C. Fedder's affidavit.

Ink drops emerging from the nozzle are aimed at the "ink return" catcher. If no voltage is applied to the charging electrodes, the drops are intercepted by the catcher and returned to the ink supply. If a positive voltage is applied, the droplets are deflected upward toward the moving document.

Each character is printed by selectively producing ink spots at certain locations on a dot matrix having nine rows and seven columns. As it moves from one column to the next, the ink drop stream is deflected successively to the nine locations (one above the others), and one or more drops can be directed to each of those locations. Drops are deflected to the nine predetermined, equally spaced positions by applying nine predetermined, and successively higher, voltage levels to the charging electrode. Each voltage level is commonly referred to as a "step" or "stair" of the "staircase" voltage. Depending on the character desired, certain locations on the matrix will require no drops. As to those locations, the corresponding "step" of the staircase volt-

age is omitted, inducing the uncharged drop to land in the "ink return." Each character is represented by an input code that translates into a series of staircase voltages having the configuration necessary to print that character.

2. *Comparison of the Burroughs Printer to an Oscillographic Recorder*

Burroughs asserts its printer is not an oscillographic machine as a matter of law. Several reasons are advanced in the Fedders affidavit:

1. Burroughs ink-jet printers cannot record waveforms of unknown shape.

2. Burroughs equipment does not reproduce waveforms because "the characters that are printed do not constitute a 'picture' or 'replica' of the incoming waveform."

3. Unlike an oscillograph, the Burroughs printer produces dot-matrix images, not a cursive line.

4. Burroughs equipment is not sold or used for oscillographic purposes.

A.B. Dick does not directly claim the Burroughs equipment is an oscillographic recorder. Instead it disputes Burroughs' second argument—the printer's inability to replicate the incoming waveform. On that score A.B. Dick adverts to part of the affidavit of J. James Stone:

In the A.B. Dick and Burroughs equipment ... the input signal to the charge

ring does represent the entire character being printed. For example, if the A.B. Dick or Burroughs equipment is set up to print the letter "R," the signal applied to the charging ring, when displayed on an oscillograph, is the letter "R." ... Both the A.B. Dick and Burroughs equipment, like the device shown in the Sweet patent, replicate the waveform of the incoming signal as the image printed by the ink jet.

Burroughs retorts that only a misuse of an oscillograph can generate even an approximate replica of the character image represented by the staircase waveforms. Referring to Stone's letter "R" example, Burroughs explains (R.Mem. 8–9):

Thus, if the staircase waveform of [the leftmost column in the 7 × 9 dot matrix] is applied to an oscillograph, the only way one might produce an "R", if at all, is to run the oscillograph much slower than intended, so as to compress the time scale—so that, instead of recording the steps of the waveform as intended, in staircase form, the oscillograph may show one step almost directly above another. Also, since the dwell time for the flat part of the step is much greater than the rise time between steps, these rise times may be suppressed, and not appear....

An analogy of this deliberate time compression, to distort the intended operation

> of an oscillograph, might be to tape record a symphony and then play it back at 100 times the intended recording speed—to hear a few seconds of noise. This obviously is a misuse of the tape recorder, assuming it could even be operated at the high speed, and effectively nullifies it for its intended purpose.

What controls however in this litigation is that by no stretch of the imagination can the Burroughs printer be viewed as an oscillograph. A.B. Dick's argument, even if true (and Burroughs clearly has the better of it), does not warrant such a finding. Merely because an oscillograph could *approximately* replicate a character (via drastic compression of the time scale) does not demonstrate the converse: that the Burroughs printer is capable of performing as an oscillograph.

As stated earlier Judge Rice employed the McGraw-Hill Encyclopedia of Science and Technology definition of an oscillograph (emphasis added):

> a measurement device for determining waveform by recording the instantaneous values of a quantity such as voltage, *as a function of time.*

But the Burroughs printer cannot record voltage signals as a function of time—no matter how the time scale is calibrated. All nine voltage levels (transmitted at *different* times) in each of the seven columns in the character matrix are recorded at the *identi-*

cal position on the "time" (horizontal) axis.[7] In short, the characters printed by the Burroughs equipment (the only type of image the equipment can record) are simply not waveforms.[8]

By the *Mead* definition, then—the definition that controls for these purposes—the Burroughs printer is not an infringing oscillographic device. That conclusion is also buttressed by specific findings underlying Judge Rice's decision on the scope of the Sweet patent. In limiting the Sweet patent claims to oscillographic recording, Judge Rice specifically held they did not disclose a device capable of producing *visible* discon-

7. Theoretically this problem could be avoided if the Burroughs printer were designed to print only one ink spot in each of the matrix columns. But its ability to generate waveforms in such hypothetical circumstances would be so circumscribed it could not be fairly classified as an oscillograph. First, it could not record waveforms with amplitudes in excess of the nine "steps." Second, it could not reproduce a *continuous* waveform unless each successive voltage quantity were within a "step" of the preceding voltage signal.

8. Even were the Burroughs characters a species of waveforms, categorizing the Burroughs printer as an oscillograph would still be highly questionable. As Burroughs points out, an oscillograph can only *imperfectly* portray a character (since its ink jet must *always* be moving). Furthermore, to provide an adequate depiction of a character the oscillograph's time scale may have to be so compressed that its underlying purpose—to record voltage values *as a function of time*—would be defeated.

tinuities in the waveform. 521 F.Supp. at 173–74. *Mead* confined the Sweet patent to oscillographic recording of *cursive* waveforms. *Id.* at 173–74, 175. In total contrast, even if the characters printed by the Burroughs equipment were to be labeled as waveforms, they are visibly *discontinuous* and non-cursive.

Conclusion

Mead determined the Sweet patent claims disclose only an oscillographic recorder. That determination binds A.B. Dick in this action under collateral estoppel principles. Burroughs' printer is not an oscillographic recorder. Accordingly Burroughs' printer does not infringe the Sweet patent as definitively construed and limited in *Mead.*

There is thus no genuine issue of material fact, and Burroughs is entitled to a judgment as a matter of law as to the Sweet patent claims.[9] This Court will await Burroughs' advice as to its antitrust counter-

9. Because this decision rests wholly on *Mead,* this Court has had no occasion to construe the Sweet patent independently. *Mead* is now on appeal, though that fact does not impair its effect for collateral estoppel purposes. This Court will leave to the litigants the taking of any protective steps (as they did with the Lewis-Brown patent) to provide for the possibility *Mead* might be reversed.

claim, the only remaining viable claim in this action.

ON COUNTERCLAIMS

At the conclusion of this Court's October 29, 1982 memorandum opinion and order (as well as during the status hearing at which the Court announced that decision granting Burroughs Corporation's motion for summary judgment), this Court invited the parties to address the Burroughs antitrust counterclaims, the only remaining viable claims in this action. Burroughs' counsel have since advised the Court of their agreement with opposing counsel under which the counterclaims may be dismissed with prejudice, subject to Burroughs' right to reinstate the counterclaims at its option if any of the patent infringement issues raised by the Complaint or Amended Complaint are reinstated at any time.

Accordingly the following final order is entered in this action:

1. A.B. Dick Company's claims of infringement of the Sweet patent by Burroughs' ink-jet printer are dismissed with prejudice, subject to reinstatement at A.B. Dick's option if Judge Rice's ruling as to the scope of the Sweet patent (*Mead Digital Systems, Inc. v. A.B. Dick Co.*, 521 F.Supp. 164 (S.D.Ohio 1981)) is reversed or vacated on appeal.

2. Burroughs' counterclaims in this action are dismissed with prejudice, subject to reinstatement at Burroughs' option if any of the issues of patent infringement asserted by A.B. Dick in this action are reinstated at any time.

APPENDIX G

A.B. DICK COMPANY, Appellant,

v.

BURROUGHS CORPORATION, Appellee.

Appeal No. 83-595.

United States Court of Appeals,
Federal Circuit.

July 27, 1983.

Upon defendant's motion for summary judgment in suit alleging patent infringement, the United States District Court for the Northern District of Illinois, Milton I. Shadur, J., 550 F. Supp. 1065 granted motion, and appeal was taken. The Court of Appeals, Jack R. Miller, Circuit Judge, held that judicial statements regarding scope of patent claims were entitled to collateral estoppel effect in subsequent infringement suit only to the extent that determination of scope was essential to final judgment on question of validity or infringement.

Reversed and remanded.

Nies, Circuit Judge, filed an opinion concurring in the result.

Appendix G

1. Judgment ⇐715(1), 720, 724

Collateral estoppel is appropriate only if issue is identical to one decided in first action, issue is actually litigated in first action, resolution of issue was essential to final judgment in first action, and plaintiff had full and fair opportunity to litigate issue in first action.

2. Judgment ⇐632

Collateral estoppel precludes plaintiff from relitigating identical issues by merely switching adversaries and precludes plaintiff from asserting a claim that plaintiff had previously litigated and lost against another defendant.

3. Judgment ⇐634

A trial court is not without some discretion to decide whether a particular case is appropriate for application of collateral estoppel.

4. Judgment ⇐634

Offensive use of collateral estoppel, where plaintiff seeks to estop defendant from relitigating issues defendant previously litigated and lost against another plaintiff, should not be allowed where it would be unfair to defendant.

5. Patents ⇐165(2)

Property right bestowed by a patent is measured, in the first instance, by the claims.

6. Patents ⇐239

One cannot avoid infringement of a patent merely by adding elements if each element recited in claims is found in accused device.

7. Patents ⇐327(13)

Judicial statements regarding scope of patent claims were entitled to collateral estoppel effect in subsequent infringement suit only to the extent that determination of scope was essential to final judgment on question of validity or infringement, and such statements had to be narrowly construed.

Dugald S. McDougall, Chicago, Ill., argued, for appellant; Keith V. Rockey, Edgar H. Schmiel and Peter S. Lucyshyn, Chicago, Ill., of counsel.

Charles W. Bradley, New York City, argued, for appellee; Steven D. Glazer, Cranford, N.J., Kevin R. Peterson and Leonard C. Suchyta, Detroit, Mich., of counsel.

Before KASHIWA, MILLER and NIES, Circuit Judges.

JACK R. MILLER, Circuit Judge.

This appeal in a patent infringement suit is from the United States District Court for the Northern District of Illinois, which granted appellee Burroughs Corporation's

("Burroughs") motion for summary judgment against appellant A.B. Dick Company ("A.B. Dick") on the basis of collateral estoppel.[1] The estoppel was premised on a previously-decided infringement action brought by A.B. Dick against Mead Digital Systems, Inc. ("Mead"),[2] wherein the United States District Court for the Southern District of Ohio held that Mead did not infringe the patent that is the subject of this suit against Burroughs. We reverse and remand.

BACKGROUND

A.B. Dick is the assignee of United States Patent No. 3,596,275 to Richard G. Sweet for "Fluid Droplet Recorder." The Sweet patent discloses a method and apparatus for applying ink drops to a sheet to form a trace. As a drop emerges from a nozzle it is given an electrostatic charge proportional to an input signal. The drop then passes a deflecting electrode having a constant electrostatic charge and is deflected thereby to a degree corresponding to the charge of the drop. Thus, by varying the charge on the drop, the amount of deflection (and, consequently, the point at which the drop im-

1. 550 F.Supp. 1065, 218 USPQ 90 (N.D.Ill. 1982).

2. *Mead Digital Systems, Inc. v. A.B. Dick Co.*, 521 F.Supp. 164, 213 USPQ 328 (S.D.Ohio 1981) (Rice, J.). Familiarity with that opinion will be presumed.

pacts a substrate) can be varied. The Sweet patent exemplifies an oscillographic recorder that forms a trace corresponding to the waveform of an input signal. Ink drops are deflected in a direction transverse to the direction the recording medium moves as a function of time. The claims in question do not specifically limit the invention in terms of direction of deflection or oscillographic recording.

Burroughs' accused device is an ink-jet dot-matrix alphanumeric character printer. It shapes letters or numbers of ink drops by deflecting drops upward to any of 9 vertical positions as the paper moves in a horizontal direction. Thus, the drops are deflected in a direction transverse to the direction the recording medium moves as a function of time.

In the prior infringement action, in which Mead sought a declaratory judgment against A.B. Dick, the District Court for the Southern District of Ohio (the "*Mead* court") held that Sweet patent claims 1 and 33[3] were valid but not infringed by Mead's

3. Claim 1 is a method claim and claim 33 is an apparatus claim. Claim 1 provides:

> 1. A method of making records on a record member by use of fluid droplets, comprising the steps of supplying writing fluid to a nozzle under pressure whereby a stream of writing fluid is projected toward the record member, applying cyclically varying energy

ink-jet "DIJIT" printer, which utilizes multiple vertically-arranged ink jets, each of which deflects ink drops only horizontally, parallel to the direction of paper movement. The *Mead* court found:

> 123. Each orifice in the DIJIT printer, and, as a result, the DIJIT system as a whole, *literally infringe* claim 1 or claim 88 of the Sweet patent, *if* "lateral" deflection in claim 1 is interpreted to include deflection *longitudinal* of the relative movement between the record member and the nozzle, *or* if deflection in

> at a predetermined frequency to the writing fluid to cause the stream issuing from the nozzle to break up into a succession of separate evenly spaced uniform droplets which move in free flight and initially in single file toward the record member, causing the stream adjacent to the nozzle to pass adjacent to a charging electrode, applying variable electrical signal values representative of the desired deflections to the charging electrode whereby individual droplets are electrostatically charged to effect different charges on at least some droplets of the succession, causing the droplets thereafter to pass in proximity to a deflecting electrode, applying a potential to the deflecting electrode to produce an electrostatic deflecting field through which the droplets pass whereby charged droplets are deflected laterally, with droplets having different charges moving through different trajectories, causing relative movement between the record member and the nozzle, and causing at least some of the droplets passing through said deflecting field to be deposited on the record member to make a record thereon.

multiple "trajectories" to multiple "regions" in claim 33 is interpreted to include deflection in that same direction.

124. Each orifice in the DIJIT printer *does not literally infringe* claim 1 or claim 33 of the Sweet patent, *if* said claims are interpreted to describe *only* deflection transverse of the time-axis of relative movement between the record member and nozzle, and thus define only oscillography.

521 F.Supp. at 180, 213 USPQ at 340. The court held, in the final judgment, that "[t]he Sweet patent is limited in scope to oscillographic recording."[4]

In this case, Burroughs' motion for summary judgment was grounded on the collateral estoppel effect of the holding of the *Mead* court that Mead did not infringe the Sweet patent. The court below, without analysis of the claims in the Sweet patent, granted Burroughs' motion because "Burroughs' printer is not an oscillographic recorder."

ANALYSIS

The issue before us is whether the *Mead* court's holding on the scope of the Sweet patent has collateral estoppel effect in this case.

4. Implicit in Burroughs' argument on appeal is the assumption that this statement refers to the scope of the claims and not merely to the scope of disclosure of utility.

[1] As properly stated by the trial court, collateral estoppel is appropriate only if: (1) the issue is identical to one decided in the first action; (2) the issue was actually litigated in the first action; (3) resolution of the issue was essential to a final judgment in the first action; and (4) plaintiff had a full and fair opportunity to litigate the issue in the first action.[5]

[2–4] Collateral estoppel "precludes a plaintiff from relitigating identical issues by merely 'switching adversaries' " and precludes a plaintiff "from asserting a claim that the plaintiff had previously litigated and lost against another defendant." *Parklane Hosiery Co. v. Shore*, 439 U.S. 322, 329, 99 S.Ct. 645, 650, 58 L.Ed.2d 552 (1979). At the same time, a court is not without some discretion to decide whether a particular case is appropriate for application of collateral estoppel. For example, offensive use of collateral estoppel, where a plaintiff seeks to estop a defendant from relitigating issues the *defendant* previously litigated and lost against another plaintiff, should not be allowed where it would be unfair to the defendant. *Id.* at 331, 99 S.Ct. at 651.

5. *Blonder-Tongue Laboratories, Inc. v. University of Illinois Foundation*, 402 U.S. 313, 91 S.Ct. 1434, 28 L.Ed.2d 788 (1971), eliminated the requirement of mutuality of estoppel in patent infringement suits involving patent claims previously held invalid in other litigation, and the parties are agreed that mutuality is not an issue in this case.

In the *Mead* case, the district court considered several interrelated issues, including validity, infringement, and, at the request of Mead, scope of the Sweet patent. A.B. Dick argues that the *Mead* court's broad statements regarding scope were not necessary to resolution of the validity and infringement issues before the court; that they were merely dicta and constitute an advisory opinion having no collateral estoppel effect. Burroughs argues that "scope" of the Sweet patent was a separate issue in Mead's declaratory judgment action; that A.B. Dick unsuccessfully argued lack of jurisdiction to decide that issue before the Mead court; and that the court's decision on the jurisdictional issue also has collateral estoppel effect.

[5] It is elementary that the property right bestowed by a patent is measured, in the first instance, by the claims. *Aro Manufacturing Co. v. Convertible Top Replacement Co.*, 365 U.S. 336, 339, 81 S.Ct. 599, 600, 5 L.Ed.2d 592 (1961); *Graver Tank & Mfg. Co. v. Linde Air Products Co.*, 339 U.S. 605, 607, 70 S.Ct. 854, 855, 94 L.Ed. 1097 (1950). The *Mead* court, in resolving the infringement question, looked to the language of claims 1 and 33 in the Sweet patent. First, it determined that the limitation in claim 1 that the droplets are "deflected laterally" was ambiguous, because "it may mean deflection 'lateral' of the undisturbed stream of droplets emitting

from the nozzle ... or it may only mean deflection 'lateral' of the relative movement between the nozzle and the paper," and that claim 33 was "ambiguous in the same manner as claim 1." 521 F.Supp. at 174, 213 USPQ at 335. Second, it determined that the Mead DIJIT printer literally infringed claim 1 only if "lateral" deflection included deflection longitudinal of the relative movement between the record member and the nozzle and that it literally infringed claim 33 only if the "trajectories" given different drops included deflection in the same direction. *Id.* at 180, 213 USPQ at 340. The *Mead* court held, on the basis of claim interpretation, that the DIJIT printer did not infringe because it did not deflect droplets transversely of the relative direction of movement between the paper and the nozzle.

By contrast, application by the court below of collateral estoppel to the question of whether the accused Burroughs machine infringes claims 1, 3, 4, 10–13, 15, 16, 18, 24–26, and 30–33 of the Sweet patent was anomalous. Despite the fact that the Burroughs printer, *unlike* the DIJIT printer, *does* deflect droplets transversely of the relative direction of movement between the paper and the nozzle, the court did not compare the several claims in issue to the accused device. Instead, using the *Mead* court's statement that the Sweet patent "is limited in scope to oscillographic recording"

rather than focusing on the claims of the Sweet patent, it determined, on affidavits submitted by the parties: "By no stretch of the imagination can the Burroughs printer be viewed as an oscillograph."

Although we express no opinion on whether there is infringement in this case, we note that the claims in issue, if infringed, would only read on a *portion* of the Burroughs machine. Thus, the Burroughs machine includes additional elements not required by the claims, such as means to generate a signal as a step function representative of various alphanumeric characters.

[6] It is fundamental that one cannot avoid infringement merely by adding elements if each element recited in the claims is found in the accused device. *See Temco Electric Motor Co. v. Apco Manufacturing Co.*, 275 U.S. 319, 328, 48 S.Ct. 170, 173, 72 L.Ed. 298 (1928). For example, a pencil structurally infringing a patent claim would not become noninfringing when incorporated into a complex machine that limits or controls what the pencil can write. Neither would infringement be negated simply because the patentee failed to contemplate use of the pencil in that environment. In the instant case, however, the presence in the Burroughs machine of elements not specified in the Sweet patent claims, such as the input signal source, and the absence in the Burroughs machine of elements not

present in the Sweet patent claims (although relied on by the court as included in the claims), such as cursive trace and rate of relative movement between the nozzle and the record member, caused the court to hold that there was no infringement. Ironically, the court relied on the collateral estoppel effect of a decision of another court which held that a different machine did not infringe because it lacked a characteristic (transverse deflection) unquestionably found in the Burroughs machine. We conclude that such an application of the doctrine of collateral estoppel to the question of infringement was erroneous.

In *Studiengesellschaft Kohle v. Eastman Kodak Co.*, 616 F.2d 1315, 206 USPQ 577 (5th Cir.1980), the Fifth Circuit considered the applicability of collateral estoppel to questions of infringement. In previous litigation over the patent claims in question, the court determined that a process for polymerizing butadiene did not infringe the patent. In so holding, the court stated that the patent was limited to the polymerization of *ethylene*. When faced with the question of whether that judicial statement estopped the same plaintiff from asserting (against a different defendant) that a process for polymerizing *propylene* infringed, the court said:

> We acknowledge that language in [*Ziegler v.*] *Phillips* [*Petroleum Co.*, 483 F.2d 858 (5th Cir.1973)] states that the '332

> patent is limited to the polymerization of ethylene. That language, however, is not necessary to the determination of the issue in *Phillips*. Only our holding that the patent was not intended to encompass the formation of high-cispolybutadiene is necessary.
>
> Because our statements limiting the patent to the polymerization of ethylene are not necessary and essential to the result in *Phillips*, they may not be used as a basis for estoppel in the present case.

Id. at 1332–33, 206 USPQ at 593. We are in agreement with this reasoning. Except in the context of validity or infringement, judicial statements regarding the scope of patent claims are hypothetical insofar as they purport to resolve the question of whether prior art or products not before the court would, respectively, anticipate or infringe the patent claims. Regardless of whether the *Mead* court had jurisdiction to rule on the abstract scope of patent claims, we are persuaded that it would be unfair to give such a ruling collateral estoppel effect. *Cf. Parklane Hosiery Co. v. Shore*, 439 U.S. at 331, 99 S.Ct. at 651 (offensive use of collateral estoppel not appropriate where it would be unfair to the defendant).

[7] In view of the foregoing, we hold that judicial statements regarding the scope of patent claims are entitled to collateral estoppel effect in a subsequent infringe-

ment suit only to the extent that determination of scope was essential to a final judgment on the question of validity or infringement; further, that such statements should be narrowly construed. Burroughs argues that the *Mead* court's holding on scope "was an integral step in the judgment of noninfringement." We agree that the *Mead* court found it necessary to consider the Sweet patent's disclosure of the claimed invention functioning as an oscillographic recorder to resolve perceived ambiguities in claims 1 and 33. The court concluded, as a result of that consideration, that those claims required deflection of ink droplets transversely of the direction of relative movement between the nozzle and the record member. It is only that conclusion that was essential to the final judgment of noninfringement. Accordingly, we do not apply collateral estoppel to the court's broader statements with respect to the scope of the patent.

In view of the foregoing, the judgment of the district court is reversed and the case is remanded for further proceedings consistent with this opinion.

REVERSED AND REMANDED.

NIES, Circuit Judge, concurring in result.

I agree with A.B. Dick that the trial court misconstrued Judge Rice's ruling in the *Mead* case and that the grant of summary judgment based on giving collateral

estoppel effect to that erroneous interpretation was improper. Hence, I join in the majority's decision to reverse. On this ground alone the appeal is resolved. I do not agree that we must also decide "whether the *Mead* court's holding on the Sweet patent has collateral estoppel effect in this case." Such an analysis would be necessary only if we agreed that Judge Rice had made the broad ruling urged by Burroughs.

I

Judge Shadur translated Judge Rice's holding that "the Sweet patent is limited in scope to oscillographic record*ing*" to mean that only devices which were "oscillographic record*ers*" could infringe. That was error. Judge Rice made a number of specific findings which shows that he did not intend to rule on what type of device was an infringement.

Finding of fact No. 124, quoted by the majority, stated unequivocally that it is "deflection transverse of the time-axis of relative movement between the record member and nozzle" that "define[s] . . . oscillography." Finding of fact No. 143 states: "Sweet's patent claims invention of means for practicing one of the number of devices for the purpose of oscillographic recording." 521 F.Supp. at 182, 213 USPQ at 342. When the expression "oscillographic recording" as used by Judge Rice is read in the context of his entire opinion, I under-

stand that he used the term as a summary description of a method of recording a wave form by "deflection of ink droplets transversely of the deflection of relative movement between the nozzle and the record member."

In view of the trial court's error in construing "oscillographic recording" to mean specific devices rather than a particular mode of operation, the grant of summary judgment is clearly unsupportable.*

II

Whether collateral estoppel effect is to be given to the limited holding as to the mode of operation of appellee's invention is not an issue between the parties. Indeed, A.B. Dick concedes that so long as Judge Rice's opinion stands, its claims are so limited, and the Burroughs' device admittedly involves deflection transverse of the relative movement between the nozzle and the record member. Whether A.B. Dick can assert no broader scope to their claims because of general principles of collateral estoppel is irrelevant.

* I also note that there is a problem, not addressed by the trial court, in giving collateral estoppel effect against independent claims 4, 10, 11, 13, 24, 25, and 30 which were not before the *Mead* court.

III

Finally, as with collateral estoppel, the discussion of adding elements to avoid infringement is a non-issue. The trial court concluded only that the Burroughs device was not an oscillographic recorder. The error below resides in the court's failing to consider that the accused device may operate by oscillographic recording, not in some confusion over what is accused of infringement. To answer the contention not raised, the majority erects a hypothesis and then strikes it down with an assumption that the result is patently correct. I do not know that the conclusion is correct and am content to await the day when the issue is raised.

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No. 83-698

In the
Supreme Court of the United States
OCTOBER TERM, 1983

BURROUGHS CORPORATION,
Petitioner,
vs.
A. B. DICK COMPANY,
Respondent.

On Petition for Writ of Certiorari to the
United States Court of Appeals for the Federal Circuit

BRIEF FOR RESPONDENT IN OPPOSITION

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RULE 28.1 STATEMENT

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Affiliated with respondent A. B. Dick Company:

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IN THE

SUPREME COURT OF THE UNITED STATES

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BURROUGHS CORPORATION,

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BRIEF FOR RESPONDENT IN OPPOSITION

Respondent agrees that this Court has jurisdiction under 28 USC §1254(1) to consider the petition for writ of certiorari in this case. The petition, however, raises no issue deserving of this Court's attention, and the complaints voiced in it are without merit.

Petitioner notwithstanding, the Court of Appeals decided this case in scrupulous compliance with this Court's guidelines. Indeed, to uphold petitioner's contentions, *this* Court would have to hold that Article III courts may issue advisory opinions, thus overturning

Hayburn's Case (1792), 2 Dall. 409, and all the countless decisions which have followed it.

This brief for respondent will begin with a counter-statement of the facts, since petitioner has not stated the case either fully or fairly.

COUNTER-STATEMENT OF THE CASE

A. The Invention Protected By The Sweet Patent.

The petition correctly states (p. 2) that this is a patent-infringement action in which respondent charged petitioner with infringement of Sweet U.S. patent No. 3,596,275. Having said that, however, the petition then subtly mischaracterizes the Sweet patent, stating (p. 2) that it "relates to an oscillographic recorder which can directly record ink drops on paper to produce a replica of the waveform of a continuously varying electrical signal". (Petitioner made that assertion without giving the Court any way to check its accuracy, the patent in suit having been omitted from petitioner's Appendix.)

The Sweet patent *is* reproduced in the appendix to this brief (pp. 1a-17a, *infra*). And perusal of it demonstrates that the expression "oscillographic recorder" does not appear anywhere in the patent. In fact, the patent does not contain the word "oscillograph" or any modified form thereof. The Sweet invention is defined in the claims of the patent as "a method of making records on a record member by use of fluid droplets" or as "a direct writing recorder" or as "liquid droplet recording apparatus". None of the claims restricts the invention to producing "a replica of the waveform", nor does any claim call for an electrical signal which is "continuously varying".

The invention of the Sweet patent, in short, is not a petty contribution useful only in limited fields of application and special situations, as petitioner implies. On the contrary, the invention introduced a wholly new mode of operation into the art of ink-jet recording, by which writing speed was increased manyfold.*

B. The A. B. Dick-Mead Litigation.

Notably, in more than a page of space devoted to respondent's infringement action against the Mead Corporation (Petition, pp. 3-4), petitioner did not even refer to the Mead jet-printing apparatus which was held to be non-infringing. Yet the distinction between Mead's machines and those involved in this case is of pivotal concern — the primary basis, in fact, for the decision below (A114-A115).

The relevant facts in that regard may be summed up thus:

(1) While the Sweet claims involved in the *Mead* case (Nos. 1 and 33) "do not specifically limit the invention in terms of direction of deflection or oscillographic recording" (A109), it is true that the illustrative droplet-recording machines described in the specification of the Sweet patent were oscillographs in which ink droplets were deflected transversely to the direction of relative movement between the record member and the ink nozzle. (See A109, A113-114.)

(2 In the ink-jet machines which were involved in the *Mead* case, all deflection of ink droplets was

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* See the opinion below, A108-A109; also see 10a, *infra*, lines 32-70.

"parallel to the direction of paper movement", rather than transverse (A110).

(3) In the petitioner's ink-jet machines (i.e., those involved in this case), the droplets are deflected in the *same* direction as in the droplet recorders described by Sweet — i.e., "in a direction transverse to the direction the recording medium moves as a function of time" (A109).

The *Mead* court held that the Sweet patent, while valid, was not infringed by the Mead machines, because, said the *Mead* court (A49), the claims of the Sweet patent must be limited by interpretation to cover only machines in which the droplets are deflected transversely. To reach that conclusion, the *Mead* court adjudged that (a) the Sweet claims 1 and 33 in suit were ambiguous in respect to direction of deflection, and (b) to resolve that ambiguity, the claims should be restricted to the type of deflection actually disclosed in the Sweet specification — i.e., deflection in the transverse direction.

In reasoning its way to that conclusion, the *Mead* court (A59) made a finding that the Sweet patent is "limited in scope to oscillographic recording"; at Mead's request (and over respondent's vehement objection), a similar recital was written into the *Mead* final judgment (A111).

C. What The District Court Did In This Case.

In this case, the District Court, on petitioner's motion, entered a summary judgment of non-infringement on the ground of collateral estoppel arising from the judgment in the *Mead* case. The asserted estoppel, however, did not stem from the *Mead* court's holding that the

Sweet patent claims must be construed to cover only machines which deflect droplets transversely. Rather, as the Court of Appeals pointed out (A114-115):

> "Despite the fact that the Burroughs printer, *unlike* the [Mead] printer, *does* deflect droplets transversely of the relative direction of movement between the paper and the nozzle, the court did not compare the several claims in issue to the accused device. Instead, using the *Mead* court's statement that the Sweet patent 'is limited in scope to oscillographic recording' rather than focusing on the claims of the Sweet patent, it determined, on affidavits submitted by the parties 'By no stretch of the imagination can the Burroughs printer be viewed as an oscillograph'."•

Thus the District Court, in summarily dismissing this case, did not even address the question whether the Sweet invention, as defined in the claims of the patent, was incorporated in petitioner's ink-jet machines. Rather, heeding only the *Mead* court's abstract statement that the Sweet patent "is limited in scope to oscillographic recording" (A111), the District Court in this case held petitioner's machine noninfringing simply because, in the Court's view, it was not an oscillograph.

D. The Decision Of The Court Of Appeals In This Case.

In reversing the District Court's judgment, the Court of Appeals — citing classic precedents from this Court — led off by noting (A113) that:

> "It is elementary that the property right bestowed by a patent is measured, in the first instance, by the claims."

• Emphasis in original.

The Court of Appeals pointed out that in *Mead* the proper procedure had been followed; that is, the *Mead* court first interpreted the Sweet claims and then resolved the infringement issue by comparing the claims as interpreted with the structure and mode of operation of the Mead machines (A113-114). In reversing the judgment in this case, the Court of Appeals simply ordered the District Court to do likewise with respect to petitioner's machines.

Concerning the *Mead* court's abstract statements as to the scope of Sweet's patent, the Court of Appeals (A116-A117) cited *Studiengesellschaft Kohle* v. *Eastman Kodak Co.* (5th Cir., 1980), 616 F.2d 1315, 1332-1333, in which the Fifth Circuit held that its own statements (in a previous case) concerning the scope of a patent could not be used as a basis for estoppel in a later case because they were "not necessary and essential to the result" reached in the prior case. The Court of Appeals expressed its approval of the *Studiengesellschaft* decision, adding (A117):

> "Except in the context of validity or infringement, judicial statements regarding the scope of patent claims are hypothetical insofar as they purport to resolve the question of whether prior art or products not before the court would, respectively, anticipate or infringe the patent claims."

Here, the Court of Appeals held (A117-A118), the *Mead* court's broad statements regarding the scope of Sweet's claims were "not essential to the final judgment of noninfringement", and hence could not be the basis for a collateral estoppel.

ARGUMENT

I. The Mead Court's Statements Concerning The "Scope" Of The Sweet Patent Were Rightly Held By The Court Of Appeals To Be Dicta; Under The Constitution The Mead Court Lacked Power To Adjudge The Sweet Patent's Scope Except In The Context Of The Accused Machines Before It.

Petitioner's plea for relief rests on an assumption which defies the Constitution — namely, the premise that the "scope" of a patent, divorced from any specific apparatus, can present a justiciable "issue" resolvable by an Article III court.

Petitioner writes glibly about "the issue of scope" (p. 7), arguing that "scope" is on all fours with such concepts as "validity" and "infringement" which really do present justiciable issues. But even brief thought confirms that "scope" is not like those other concepts. Thus, given the factual background and the applicable legal standards, a court *can* decide whether a patent claim is valid and can then rule for the plaintiff or defendant as its resolution of the validity issue dictates. Again, applying the relevant legal standards to the facts of a case, a court can determine explicitly, one way or the other, whether a patent claim has been infringed by a specific accused device and then decide the case accordingly, for plaintiff or defendant. But no such definitive issue can be formulated with respect to the abstract "scope" of a patent claim. Even after a court has tried to define by metes and bounds precisely what a claim embraces within its scope, the court still cannot decide the case for plaintiff or defendant until it has

determined whether the specific accused device before it is within or without the patent's reach.

Plain as day, in other words, a court which undertakes to define the abstract "scope" of a patent is not adjudging a dispute; it is writing a treatise. And all judicial statements concerning "scope" which go outside the arena bounded by the devices actually before the court for adjudication are, as the Court of Appeals said in this case (A117), "hypothetical insofar as they purport to resolve the question of whether prior art or products not before the court would, respectively, anticipate or infringe the patent claims".

That very fact defeats petitioner's contention that an abstract "issue of scope" can be justiciable, it being elementary (a) that Article III courts do not "decide abstract, hypothetical or contingent questions", and (b) Article III courts are "without power to give advisory opinions".*

While petitioner has studiously avoided any reference to the Constitutional ban on hypothetical questions and advisory opinions, the petition does tacitly confess that what the defendant in the *Mead* case sought was an advisory opinion. As petitioner points out (p. 7), Mead was "in the ink-jet printing business", and it "filed a declaratory judgment action in which it sought to have the scope of the Sweet patent determined". But the *only* controversy between Mead and respondent which existed

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* As this Court has held over a span of nearly two centuries. See *Alabama Federation of Labor* v. *McAdory* (1945), 325 U.S. 450, 461, (citing *Hayburn's Case* (1792) 2 Dall. 409), *Golden* v. *Zwickler* (1960), 394 U.S. 103, 108, and *Ashcroft* v. *Mattis* (1977), 431 U.S. 171, 172.

at that time was their dispute concerning the ink-jet machines Mead had on the market. Respondent had no knowledge of — and made no charges concerning — ink-jet machines that Mead might develop in the future; and of course no such imaginary machines were submitted to the *Mead* court for appraisal. So a declaratory judgment broadly defining the Sweet patent's scope could (a) rest only on hypothetical foundations, and (b) have no function except to *advise Mead* how to avoid hypothetical *future* disputes with respondent!

The *Mead* court's statements purporting to define in the abstract the scope of the Sweet patent are directly comparable to the declaratory judgment this Court set aside in *Golden* v. *Zwickler* (1969), 394 U.S. 103. In that case, the plaintiff Zwickler had been indicted, but not convicted, under a New York anti-handbill statute. After the state criminal action against Zwickler had been dismissed, Zwickler brought an action in United States District Court seeking a declaratory judgment that the statute under which he had been indicted was unconstitutional. The District Court gave Zwickler such a judgment, but this Court unanimously reversed, holding that Zwickler's desire to have a declaratory judgment as a guide for his future conduct did not create an "actual controversy" justiciable in an Article III court.

While petitioner refuses to face it, the lesson taught by *Zwickler* is clear: Just as the District Court had no power to issue an advisory opinion to guide Zwickler's future political activities, so also did the *Mead* court have no power to issue an advisory opinion respecting the "scope" of the Sweet patent, to guide Mead's future ink-jet engineering.

In sum, the *Mead* court's judicial statements concerning "scope" did *not* have the force of a judgment. They were, as the Court of Appeals held, only dicta except in the specific context of the infringement issue which was before the *Mead* court for decision. The Court of Appeals decided this case (A116) on the authority of *Studiengesellschaft Kohle* v. *Eastman Kodak Co.* (5th Cir., 1980), 616 F.2d 1315, 1332-1333, *cert. den.* (1980), 449 U.S. 1014; and its decision applied the rule that no collateral estoppel can arise from a statement or holding in another case unless it was "necessary to the outcome of the first action" (*Parkland Hosiery Co.* v. *Shore* (1979), 439 U.S. 322, 326, n.5). Hence, petitioner errs in asserting (p. 5) that the Court of Appeals failed to heed this Court's decisions.

II. The Decision Below Was Correct For An Independent Reason: The Patent Law Requires That A Patent's Claims Be Consulted To Determine What The Protected Invention Is.

It is elementary, as the Court of Appeals pointed out (A113), that the property right bestowed by a patent is measured in the first instance by the claims. In support of that proposition, the Court of Appeals cited two of this Court's recent decisions (*Aro Mfg. Co.* v. *Convertible Top Co.* (1961), 365 U.S. 336, 339, and *Graver Tank & Mfg. Co.* v. *Linde Co.* (1950), 339 U.S. 605, 607); and it could have cited countless others, including such venerable authorities as *White* v. *Dunbar* (1886), 119 U.S. 47, 51-52, and *McClain* v. *Ortmayer* (1891), 141 U.S. 419, 424.

Equally elementary is the principle that infringement of a patent (or the absence thereof) shall be determined by comparing the words of the claims with the accused

product. The most widely quoted statement of that rule is probably the one written by Mr. Justice Jackson in *Graver Tank & Mfg. Co.* v. *Linde Co.* (1950), 339 U.S. 605, at 607:

> "In determining whether an accused device or composition infringes a valid patent, resort *must* be had in the first instance to the words of the claim. If accused matter falls clearly within the claim, *infringement is made out* and that is the end of it."•

As the Court of Appeals took pains to point out (A114-A115), the District Court in this case did not follow the procedure prescribed by Justice Jackson. In fact, the District Court did not even consider the claims of the Sweet patent in reaching the conclusion that the patent has not been infringed by petitioner's ink-jet machines. Rather, the District Court (A114-115) seized upon the *Mead* court's statement that the Sweet patent "is limited in scope to oscillographic recording" and jumped at once to the conclusion that petitioner's machines (which *do* utilize transverse deflection) do not infringe because they aren't oscillographs.

In remanding this case to the District Court, the Court of Appeals pointed out (A118) that the *Mead* court's statements with respect to "oscillographic recording" were incidental steps contributing to the *Mead* court's conclusion that Sweet's claims 1 and 33 "required deflection of ink droplets transversely of the direction of relative movement between the nozzle and the record member", and that the *Mead* court's final judgment of noninfringement was arrived at by comparing the claims, as thus interpreted, with the accused Mead machines.

• Emphasis added.

On remand, the Court of Appeals made clear (A115-A116), the District Court in this case should similarly follow the statutory procedure in deciding whether petitioner's machines infringe the Sweet patent.

Thus, entirely apart from the point made under heading I of this argument, the decision below was correct and should not be disturbed.

CONCLUSION

This case was rightly decided, with no novel or disputed point of law involved. The petition for certiorari should be denied.

Respectfully submitted,

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APPENDIX

United States Patent

[11] 3,596,275

[72] Inventor Richard G. Sweet
C/O Minneapolis-Honeywell Regulator Co., Philadelphia Division, Wayne & Woodrim Avenues, Philadelphia, Pa. 19144

[21] Appl No. 354,659
[22] Filed Mar. 25, 1964
[45] Patented July 27, 1971
Continuation-in-part of application Ser. No. 298,996, July 31, 1963, now abandoned.

[54] FLUID DROPLET RECORDER
33 Claims, 15 Drawing Figs.

[52] U.S. Cl. 346/1, 346/75, 317/3
[51] Int. Cl. G01d 15/18
[50] Field of Search 346/75, 140; 317/3, 239/3, 4, 15; 178/96

[56] References Cited
OTHER REFERENCES

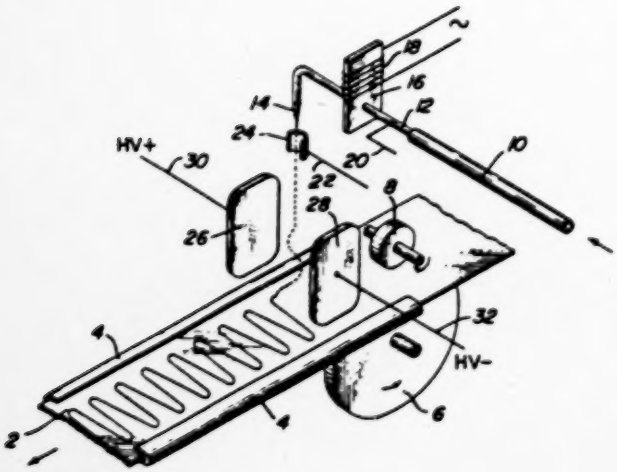
Magarvey & Taylor; Apparatus For The Production Of Large Water Drops; The Review of Scientific Instruments, Vol. 27, No. 11, Nov. 1956, pages 944-947.

Hendricks; Charged Droplet Experiments; Journal Of Colloid Science, Vol. 17, No. 3, March 1962, Pages 249-259.

Magarvey & Blackford; Experimental Determination Of The Charge Induced On Water Drops, Journal Of Geophysical Research, Vol. 67, No. 4, April 1962, pages 1421-1426.

Primary Examiner—Joseph W. Hartary
Attorney—Plehr & Swain

ABSTRACT: A direct writing signal recording system which writes on a record medium by projecting a stream of writing fluid in the form of a succession of uniformly spaced droplets. The droplets are charged electrostatically in accordance with instantaneous signal values and then deflected electrostatically in accordance with the charges carried by the droplets. Droplets may be directed to intercepting means whereby droplets so directed are not deposited on the record medium.



PATENTED JUL 27 1971

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SHEET 1 OF 7

FIG. 1

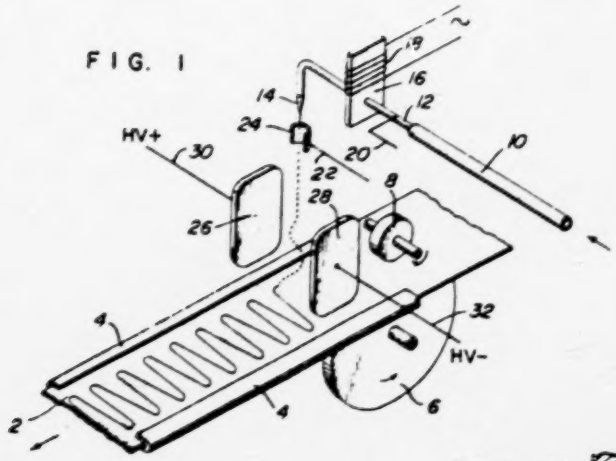


FIG. 2

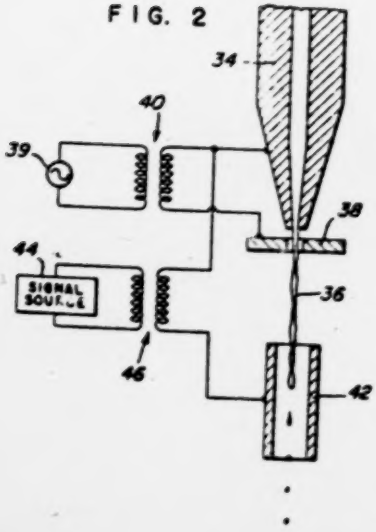
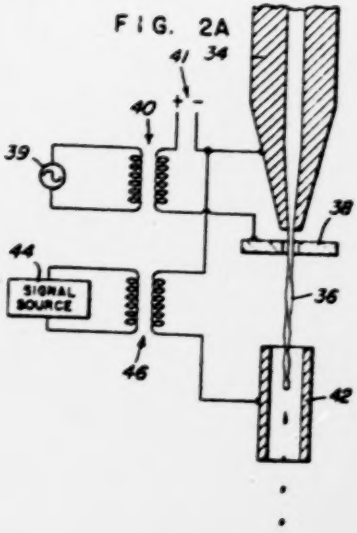


FIG. 2A



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FIG. 3

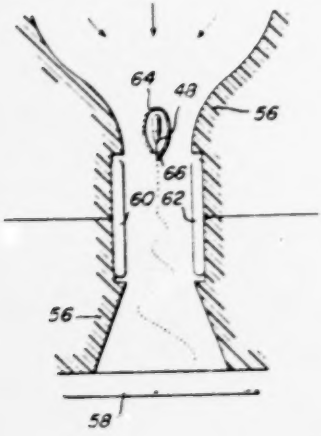


FIG. 4

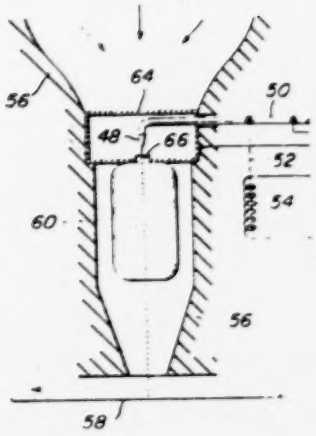
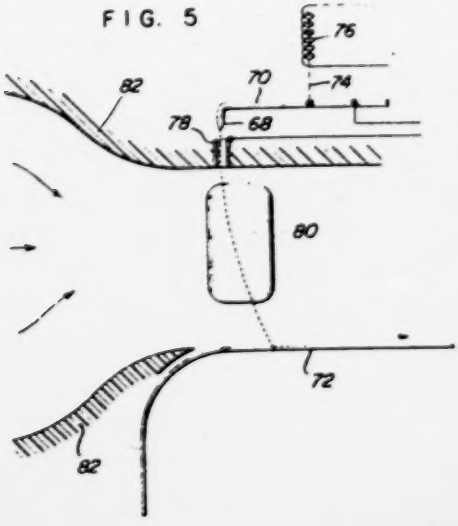


FIG. 5

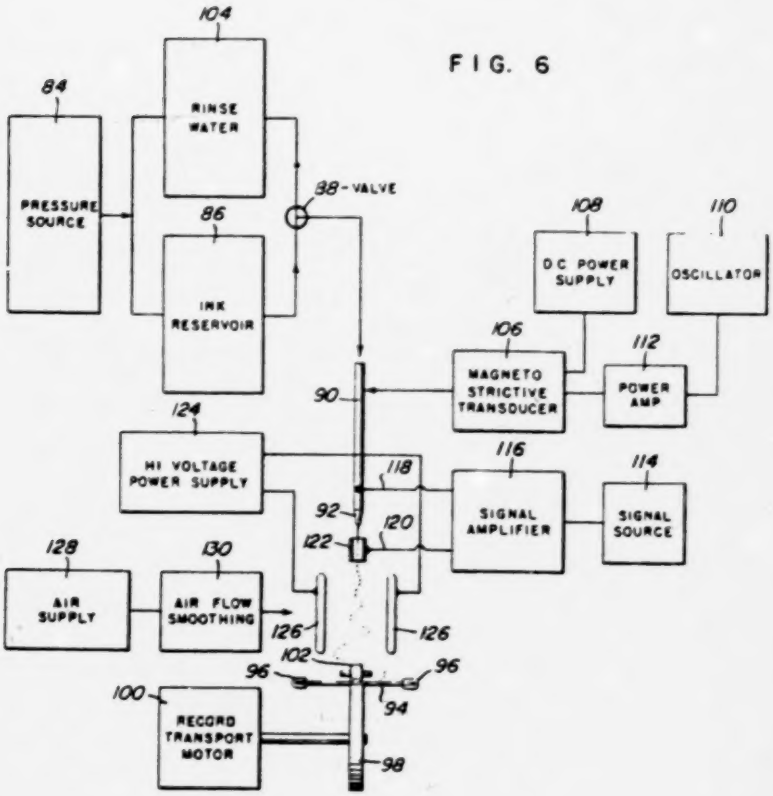


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FIG. 6



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PATENTED JUL 27 1971 3,596,275

SHEET 4 OF 7

FIG. 7

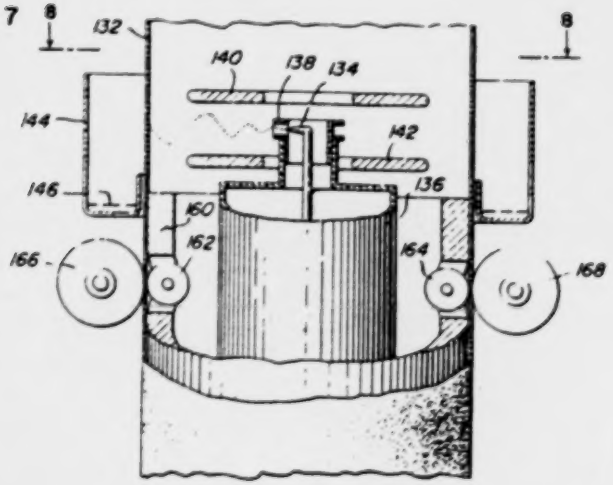
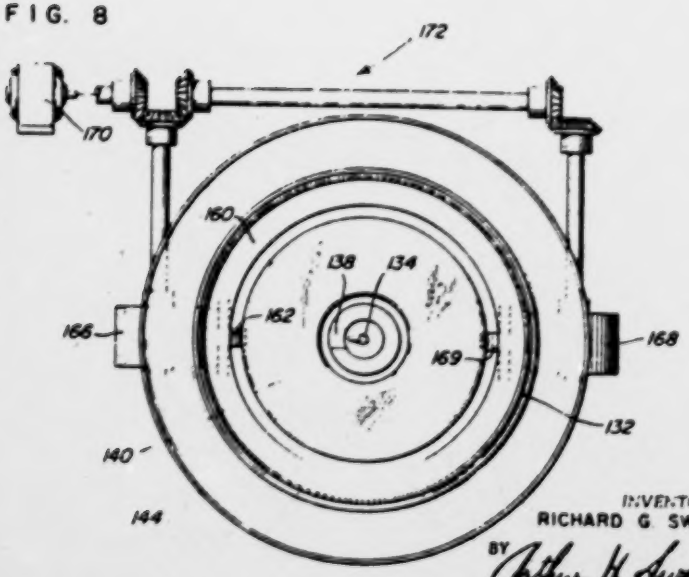


FIG. 8



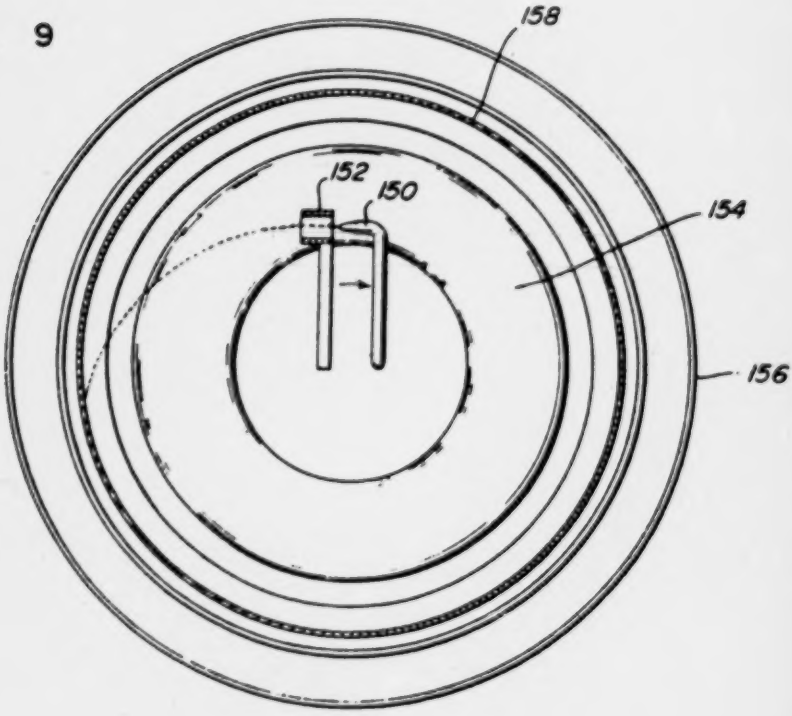
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PATENTED JUL 27 1971

3,596,275

SHEET 5 OF 7

FIG. 9



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PATENTED JUL 27 1971 3,596,275

SHEET 6 OF 7

FIG. 11

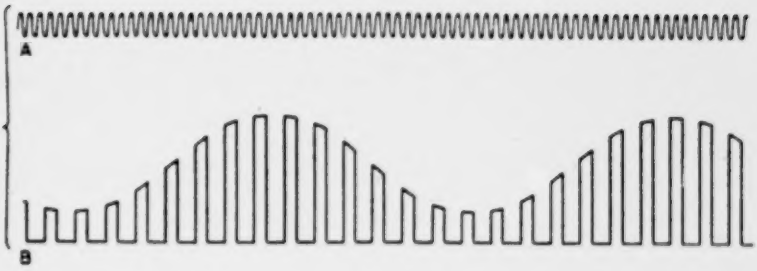


FIG. 12A

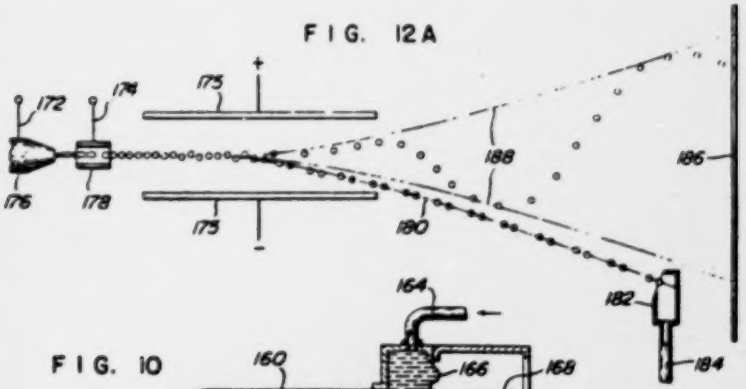
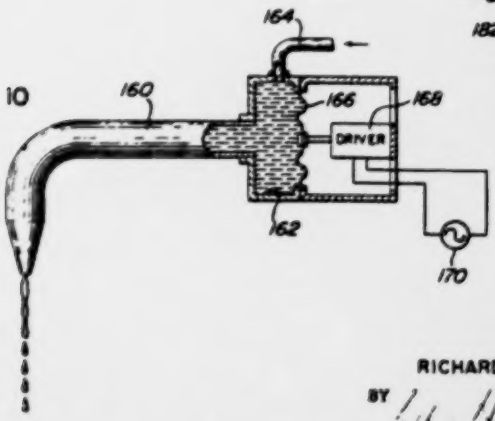


FIG. 10



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PATENTED JUL 27 1971 3,596,275

SHEET 7 OF 7

FIG. 13

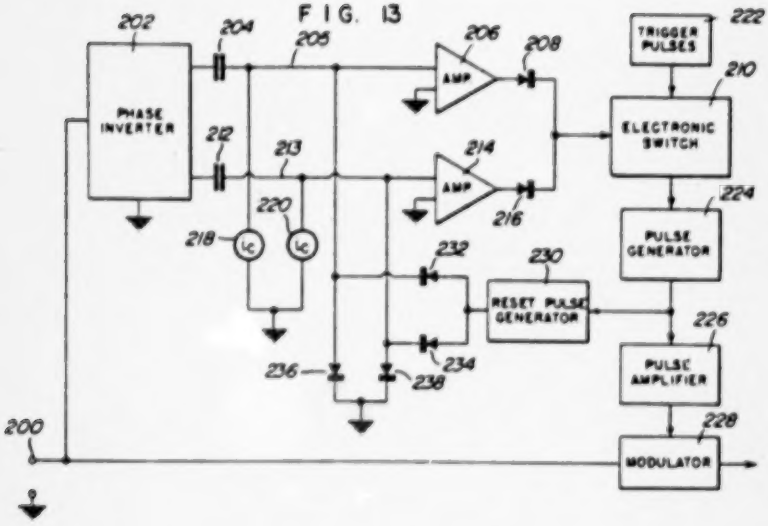
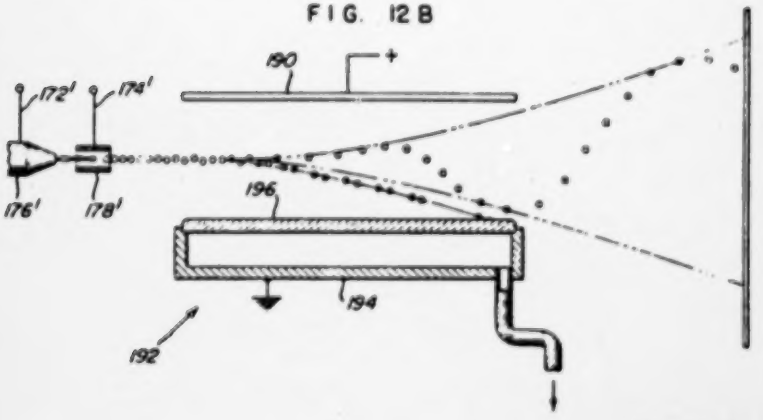


FIG. 12B



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PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,596,275 Dated July 27, 1971

Inventor(s) Richard G. Sweet

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

First page [72] correct applicant's address to read as follows: --Richard G. Sweet, 747 Layne Court, Palo Alto, CA 94303--; [56] Under "References Cited" insert the following:

--United States Patents

1,882,043	10/1932	Schroter	178-96X
2,512,743	6/1950	Hansell	118-300
2,577,894	12/1951	Jacob (A)	346-75
2,600,129	6/1952	Richards	317-3
2,676,868	4/1954	Jacob (B)	346-75
3,060,429	10/1962	Winston	346-1 --

[56] In first and third cited "Other References" correct "Magaruey & Taylor" to read --Margarvey & Taylor--. Column 2, line numbered 40 (actually 39) substitute --The-- for "THe". Column 3, line numbered 59 (actually 57), substitute --The-- for "THe". Column 5, line numbered 35 (actually 34) substitute --The-- for "THe". Column 7, line numbered 41 (actually 40) delete "of"; same line, substitute --into-- for "onto". Column 8, line numbered 16 (actually 15) substitute --These-- for "THese"; column 8, line numbered 22 (actually 21) substitute --Thus-- for "THus". Column 10, line numbered 36 (actually 35) substitute --The-- for "THe"; column 10, line numbered 47 (actually 46) after "continue to" insert --operate.--; column 10, line numbered 48 (actually 47) change "the repetition" to --The repetition--. Column 12, line numbered 33 (actually 32) substitute--member-- for "members"; column 12, line numbered 44 (actually 43) substitute --charges-- for "variable". Column 14, line 29, after "record" insert --receiving--.

Signed and sealed this 28th day of March 1972.

ROBERT GOTTSCHALK
Commissioner of Patents

Attesting Officer

1

FLUID DROPLET RECORDER

The present application is a continuation-in-part of application Ser. No. 298,996, filed July 31, 1963 and now abandoned.

This invention relates to signal apparatus, and more particularly to a direct writing signal recording system.

It is an object of the present invention to provide an improved recording system which is capable of recording a wide band of input signals which may vary in frequency from direct current signals to signals having frequencies in the kilocycle range.

It is another object of the present invention to provide an improved recording system as set forth and wherein direct ink recording is employed while obviating the necessity for a physical engagement between a stylus and the record member.

It is a further object of this invention to provide a recording instrumentality as set forth which incorporates the versatility of electrostatic deflection while retaining the advantages of immediate visibility and permanency of direct ink recording.

In accomplishing these and other objects, there has been provided, in accordance with the present invention, a recording instrument wherein a jet of writing fluid or ink is caused to issue from a nozzle in the form of a succession of tiny individual droplets which are directed toward the surface of a record member. As the individual droplets are formed, they are given an electrostatic charge which is a function of the instantaneous value of an input signal which is to be recorded. The charged droplets are caused to pass between a pair of electrostatic deflection plates. A constant high-voltage charge is applied to the deflection plates to produce a constant high-voltage electric field between the two plates. As the charged droplets pass through the electric field, they are deflected from their normal path by an amount which is a function of the magnitude of the charge on each of the droplets and in a direction which is a function of the polarity of the charge on the individual droplets. Means are provided for assuring that the droplets occur at regular intervals and are uniform in size.

A better understanding of this invention may be had from the following detailed description when read in connection with the accompanying drawings, in which:

FIG. 1 is a perspective view of apparatus embodying and illustrating the present invention;

FIG. 2 is a fragmentary cross-sectional view of a somewhat different form of one of the details of the apparatus embodying the present invention;

FIG. 2A is a view similar to FIG. 2 but showing a DC bias on the charging circuit.

FIGS. 3 and 4 are two mutually perpendicular sectional views schematically illustrating means for introducing a stream of air which is collinear with the stream of ink droplets in apparatus such as that shown in FIG. 1;

FIG. 5 is a side view schematically representing means for introducing a stream of air which is perpendicular to the stream of ink droplets in apparatus such as that shown in FIG. 1;

FIG. 6 is a block and schematic diagram representing a recording system constructed in accordance with the present invention;

FIG. 7 is a schematic representation illustrating a cross-sectional view of a somewhat different form of apparatus embodying the present invention;

FIG. 8 is a top view taken along the line 8–8 of FIG. 7;

FIG. 9 is a view similar to that of FIG. 8 but showing a still different structure embodying the present invention;

FIG. 10 is a fragmentary view of a portion of the system somewhat similar to that shown in FIG. 2 and 2A but illustrating a different form of apparatus for carrying out the function;

FIG. 11 is a pair of wave trains illustrating the time relationship of certain functions of the apparatus illustrated in FIGS. 12A, 12B, and 13;

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FIGS. 12A and 12B are schematic representations of a somewhat different form of structure also embodying the present invention; and

FIG. 13 is a schematic circuit diagram of a controlled circuit for use in effecting the operation illustrated in FIG. 12.

Referring now to the drawing in more detail, there is shown in FIG. 1 apparatus which illustrates the inventive concept constituting the present invention. This apparatus includes a record receiving member 3, such as a strip of record paper, which is arranged to be driven through a suitable paper guide 4 by means of a drive roller 6 and a pressure roller 8. Record writing fluid is supplied to the system through a tube member 10, a feed pipe 12 and a nozzle 14 under a hydrostatic pressure head of between 40 and 100 lbs. per square inch. The writing fluid, or ink, issues from the nozzle 14 in a jet which may be on the order of 1/1,000 of an inch in diameter. Issuing thus from the nozzle, the jet has a natural tendency, due at least in part to surface tension of the fluid, to break up into a succession of tiny droplets. In order to assure that the droplets will be substantially uniform in dimension and frequency, means are provided for introducing regularly spaced varicosities in the issuing jet. These varicosities, or undulations in the cross-sectional dimension of the issuing jet stream, are made to occur at or near the natural frequency of the formation of the droplets. This frequency may typically be on the order of 120,000 per second. In the structure shown in FIG. 1 the varicosities are introduced into the issuing jet stream by vibrating the feed pipe 12, hence the nozzle 14, at the desired frequency. This is accomplished by means of a magnetostrictive driving element 16 which is excited by a suitable driving coil 18.

In accordance with this invention, the signals to be recorded are applied directly to the writing fluid. In accomplishing this it is assumed that the writing fluid, or ink, is, itself, electrically conductive. The signal to be recorded is applied to the instrument over a first and second lead wire 20 and 22, respectively. The first lead wire 20 is connected to the feed pipe 12, if that feed pipe 12 is made of electrically conductive material. Otherwise the lead 20 is connected through the wall of the feed pipe 12 into engagement with the ink therewithin. The second lead wire 22 is connected to a tubular charging ring or electrode 24. The charging electrode 24 is positioned to surround the path of the ink jet and is positioned relative to the nozzle 14 such that the actual formation of the discrete droplets occurs within the region surrounded by the electrode 24. Thus, as an individual droplet separates from the continuous stream of the ink supply, it carries with it an electrostatic charge which is proportional to the instantaneous value of the input signal at the instant of separation. Thus each droplet of ink or writing fluid will have its own unique charge characteristic.

These droplets are directed, at relatively high velocity, toward the surface of the record receiving member 3. In their path towards the surface of the record receiving member 3, the droplets are caused to pass between a pair of electrostatic deflecting electrodes or plates 26 and 28, respectively. These plates 26 and 28 are oppositely charged to a relatively high constant voltage. The deflecting plate 26 might, for example, be charged to a positive 8,000 volts through the lead 30, while the plate 28 might be charged to a negative 8,000 volts through the lead 32. This produces an electric field between the two plates having a total potential difference of 16,000 volts with the two plates spaced about one-half inch apart. As the individually charged droplets pass through the electric field thus produced, they are individually deflected from their straight line path by an amount which is a function of the magnitude of the charge on the particular droplet. The direction of the deflection will be determined by the polarity of the charge on the droplet relative to the electric field.

Since the charge on the deflection plates is constant and the signal to be recorded appears as a charge on the individual droplets, the frequency response characteristic of the recording instrument is not limited by the transit time of the droplets between the deflection plates. Since each droplet carries its

own unique charge signal, the frequency response capability of the recording instrument is limited only by the frequency of the reoccurrence of the individual droplets. With the droplets occurring at the rate of 120,000 per second, it is apparent that the frequency response characteristic of the recorder approaches one-half of the recurrent frequency of the droplets themselves as a practical limit.

The structure shown in FIG. 2 is somewhat different from that shown in FIG. 1 in that a different means is provided for introducing the varicosities in the jet stream issuing from the nozzle. In that figure a nozzle 34 is shown from which the ink or writing fluid 36 issues in a stream. It is assumed for the purpose of this illustration, that both the nozzle and the writing fluid are electrically conductive. Very closely adjacent the issuing end of the nozzle and surrounding the jet stream there is a first or excitation electrode 38. A high frequency voltage source 39 is coupled by means of a transformer 40 to the nozzle 34 and the excitation electrode 38. The frequency of the applied signal is, of course, determined by the frequency at which the droplets are to be formed. That drop formation frequency is, in our illustrative example, 120,000 drops per second. Unless a DC bias is employed, the applied signal frequency will be one-half that of the drop formation frequency. Alternatively, as shown in FIG. 2A, a DC bias from the source 41 may be superimposed upon the high frequency excitation signal from the source 39 and applied to the excitation electrode 38. With the use of the DC bias, the double-frequency effect would be eliminated. Accordingly, in that case the frequency of the applied high frequency excitation would be identical to that of the desired drop rate. Since, as was assumed, both the nozzle and the fluid are electrically conductive, the application of the high frequency signal as thus described results in the production of a radially extending pulsating electrostatic field between the fluid stream and the electrode 38. The electrostatic forces thus produced cause pulsating stresses to be formed within the fluid stream, thereby introducing the desired varicosities. Positioned further along the fluid stream and surrounding that stream there is a charging electrode 42, comparable in position and function to the charging electrode 24 of FIG. 1. Signals to be recorded from a source 44 are coupled through a transformer 46 to the charging electrode 42 and a nozzle 34 whereby to impart signal charges to the formed droplets, as in the case of the structure shown in FIG. 1.

In the practice of this invention, it was found that under certain conditions an undesirable distortion was introduced into the record. It was further found that a cause of such distortion could be traced to the turbulent wake of each droplet affecting the movement of the succeeding droplets when the droplets follow each other along the same or approximately the same path. One approach to alleviating such distortion is shown schematically in FIG. 3 and 4. In the form of the invention there shown, the relative velocity of the droplets with respect to the ambient air is substantially reduced by introducing a stream of air which flows collinearly with the stream of droplets. As in the basic structure shown in FIG. 1, ink is supplied to a nozzle 48 through a feed pipe 50. This feed pipe, and hence, the nozzle 48 is vibrated by a magnetostrictive driver 52 which is, in turn, excited by a driving coil 54. As before, the frequency of the vibration is about 120,000 cps. The nozzle 48 projects into a passageway defined by a suitable wall means 56. The wall 56 is contoured to define a passageway that embraces substantially the entire path of the ink, or writing fluid, between the nozzle 48 and the surface of the record receiving member or paper 58. Within the passageway defined by the walls 56 there is located a pair of deflecting electrodes 60 and 62, respectively. Through suitable means, not shown, a constant flow of air is supplied, care being taken to assure that the flow of air through the passageway is laminar. In order to preserve the laminar flow of air through the passageway, particularly in the vicinity of the nozzle 48, the charging electrode is made in the form of a hollow streamlined strut 64 which surrounds that part of the nozzle 48 and feed pipe 50 which projects into the passageway. A small opening 66 is provided in the trailing edge of the strut 64, located opposite the end of the nozzle, through which the ink is projected toward the record receiving member 58. Since the several electrodes involved in this system are in at least closely spaced relation to the wall means 56, if not actually in physical contact with it, and since these electrodes carry relatively high voltages, it is preferable that the wall means be formed of an insulating material such as a suitable plastic.

With the flow of air moving smoothly in the same direction as the projected droplets, the tendency for rapidly moving droplets to produce a disturbing wake is greatly reduced. In a successfully operated recorder constructed in accordance with the embodiment of the invention, an ink stream or jet length of substantially 2 inches, a velocity of the projected droplets of about 575 inches per second and an air stream velocity of between 380 and 500 inches per second was used and found to give satisfactory results.

Another form of structure embodying the present invention and also providing means for obviating the disturbing effect of turbulent wake from the droplets is shown schematically in FIG. 5. In that form, the structure includes, as before, a nozzle 68 and a feed pipe 70 for projecting a stream of ink droplets toward the surface of a record receiving member 72. Here, too, means such as a magnetostrictive driver 74, excited by a driving coil 76, is provided for vibrating the feed pipe 70, and, hence, the nozzle 68, to produce the desired varicosities in the issuing ink stream. These varicosities, as previously mentioned, result in the formation of droplets which are uniform in size and spacing. The jet or stream of ink is charged in accordance with an input signal as it passes through a cylindrical charging electrode 78. It then, as before, passes between a pair of deflecting electrodes 80.

In this form, a constant velocity laminar stream of air is introduced into the system in the region through which the stream of droplets flows, the direction of the air stream being perpendicular to the ink droplet stream and collinear with the movement of the record receiving member. The air stream is controlled and directed by a passageway defined by wall means 82 which are, again, preferably made of an insulating material such as a suitable plastic. With the air stream flowing perpendicularly to the ink droplet stream, the disturbing turbulence of the droplet wake is carried downstream with the air flow. Thus, the wake of one droplet cannot influence the movement of succeeding droplets. The perpendicular flow of air will, of course, cause a bending of the stream of ink droplets, as indicated in the drawing. However, since the droplets are all of the same dimension and the air flow velocity is constant and laminar, the amount of the bending of the ink droplet stream is constant and may be calibrated into the recorder.

In a successfully operated recorder constructed in accordance with this embodiment of the invention, an ink jet length of about 1.25 inches, an ink drop velocity of about 1,000 inches per second, and an air stream velocity of about 420 inches per second was found to give satisfactory results.

In FIG. 6, there is shown a schematic representation of a complete recording system constructed in accordance with the present invention. A pressure source 84 is provided for establishing and maintaining a desired predetermined pressure head on an ink reservoir 86. The ink in the reservoir 86 is fed, under the selective control of a valve means 88, to a feed pipe 90 and, by the feed pipe, to a nozzle 92. The pressure on the ink supplied to the nozzle 92 causes the ink to be projected from the nozzle 92 toward a record receiving member 94. The record receiving member 94 is advanced at a predetermined velocity, through suitable guide means 96 by a drive roller 98 which is, in turn, driven by a suitable record transport motor 100. The drive roller 98 engages one surface of the record receiving member 94 while a pressure roller or idler 102 engages the opposite surface of the record receiving member 94.

When the recorder is to be turned off and not used for a time, it is desirable that ink be not allowed to stand in the noz-

zle 94. Since the inside diameter of the nozzle is on the order of one-thousandth of an inch, ink allowed to stand therein might tend to clog the opening when the ink has dried. One way of removing the residual ink from the nozzle is to wash it out with a suitable solvent which may well be water. To that end, a reservoir 104 is provided which contains rinse water. The pressure source 84 is also connected to the reservoir 104 to establish a suitable pressure head therein.

The valve means 88 is selectively operable to interrupt the flow of ink from the reservoir 86 and to substitute a flow of rinse water through the nozzle. Of course, it is contemplated that flow from both reservoirs may be cut off. It is further contemplated that the illustrative valve means 88 might well include a separate valve member for the water and ink supply lines.

In order to vibrate the feed pipe 90, hence, the nozzle 92, to introduce the varicosities previously mentioned, there is provided an electromechanical transducer 106 which is mechanically coupled to the feed pipe 90. The electromechanical transducer 106 may well be a magnetostrictive unit as mentioned hereinbefore. A DC power supply 108 provides a suitable bias to the transducer 106 to eliminate a double frequency pulsation. An oscillator 110 provides an oscillatory signal which, when amplified by a power amplifier 112, is applied as a driving signal for the transducer 106. Thus, if the desired rate of occurrence of the ink droplets 120,000 per second, the oscillatory signal produced by the oscillator is also 120 kilocycles per second.

The intelligence signals which are to be recorded are derived from any suitable signal source 114. The signal source 114 may be substantially any means for producing an electric signal representative of a variable quantity being monitored. The signals from the source 114 are amplified by a signal amplifier 116. THe amplified output signals of the amplifier 116 appear across a pair of output leads 118 and 120. The first of these leads is coupled to the ink in the feed pipe 90 by connection to or through the feed pipe 90. The other lead 120 is connected to a charging electrode 122. As previously explained, the charging electrode 122 surrounds the issuing ink stream in the region where the stream breaks up into a series of discrete droplets. Under these conditions, the individual droplet will carry with it an electrostatic charge which is a function of the instantaneous value of the signal appearing across the two leads 118 and 120 at the instant of separation of the droplet from the body of the ink.

A high voltage power supply 124 produces a constant DC output voltage of a suitable high value. In a successfully operated recorder constructed in accordance with this invention, the power supply produced a positive 8,000 volts and a negative 8,000 volts for a total potential difference of 16,000 volts. The output of this power supply 124 is connected to a pair of deflection electrodes 126 positioned about one-half inch apart, respectively, on opposite sides of the stream of charged ink droplets. Thus energized and positioned, the deflecting electrodes 126 produce a substantial electric field between them. Each droplet, as it passes through this field, in accordance with the laws of charged particles moving in an electric field, is deflected from its original course by an amount which is a function of the magnitude of the charge on the droplet in a direction which is a function of the polarity of the charge on the droplet, the polarity and magnitude of the electric field being predetermined and constant.

In order to minimize the occurrence of distortions in the recording of signals occasioned, as previously described, by the effect of the wake of one droplet on the path of succeeding droplets, there is provided a source of air flow 128. Air flowing from this source 128 is caused to pass through an air flow smoothing filter 130 to produce laminar flow of the air. The laminar flow of air is then directed to flow through the region embracing the path of the ink droplets. The direction of the air flow may be either collinear with the flow of the ink droplets, as shown in FIGS. 3 and 4, or perpendicular to the flow of ink, as shown in FIG. 5. It will also be apparent that a flow of air may well be in a direction which is intermediate to the collinear and perpendicular flows.

A different form of structure which also embodies the present invention is shown in FIGS. 7 and 8. On that form, the record receiving member 132 is a relatively wide web member which, at the recording position, is formed into a cylinder. Suitable means are provided for advancing the record receiving member, relative to the recording position, in a direction which is axial of the formed cylinder. The record receiving member 132 is formed into a cylindrical configuration about a cylindrical record guide member 160. The guide member carries a pair of pressure idler rollers 162, 164, respectively, at diametrically opposite locations. These rollers 162 and 164 are mounted in suitable recesses in the walls of the guide member in positions to engage the inner surface of the record member 132. A pair of driving rollers 166 and 168 are mounted externally of the cylinder formed by the record member 132 in a position to engage the outer surface of the record member 132 opposite, respectively, the pressure rollers 162, 164. The two drive rollers 166 and 168 are synchronously driven as from a common source, such as a motor 170, by means of a suitable drive coupling 172. Another means for advancing the record member may be substantially similar to that shown in the U.S. Pat. No. 2,912,518, issued in the name of A. R. Massey. The stream of ink droplets is projected from a nozzle 134, as before. In this instance, however, the nozzle 134, together with its associated elements, as indicated at 136, is mounted on means, not shown, for rotating the nozzle about the axis of the cylinder defined by the record receiving member 132. The ink droplets from the nozzle 134 are projected through a charging electrode 138, which is also part of the rotating structure. The charged droplets then pass between a pair of deflecting electrodes 140 and 142, respectively. In this structure, the deflecting electrodes are each in the form of a flat toroid or ring. The two ring-shaped electrodes are supported in parallel spaced relation so that the ink droplets may freely pass between them.

As the nozzle 134 and its associated elements rotate, the projected ink stream would tend to lay down a circular trace on the record member 132. However, since the record member 132 is being advanced through the instrument at a uniform rate, the ink trace becomes basically a helix. The deflection of the ink droplets, in accordance with the signal charge on them, will be in a direction transverse of the basic helix rather than transverse of the direction of travel of the record member, as in the structures hereinbefore described. Since the nozzle rotates as the ink is being emitted, each droplet follows a path which is slightly displaced about the axis of rotation of the nozzle from that of the preceding droplet. Thus, the droplets do not follow each other along the same path, hence they avoid the influence of the wake of the preceding droplets.

Since the ink is projected from the rotating nozzle 134 at relatively high velocity, if the instrument should happen to be turned on when no record receiving member is in place, a rather disturbing mess might ensue. In order to avoid such an occurrence, there is provided an ink collector ring 144 which is positioned externally of the record member position and bridging the free space between the two deflecting electrodes 140, 142. The collector ring 144 is formed with a trough 146 along its lower edge. Thus, if the instrument should be turned on when no recording paper is in position, or if the supply of recording paper runs out while the instrument is still in operation, any projected ink that escapes beyond the position of the record member 132 will be intercepted by the collector ring 144. THe intercepted ink will be collected in the trough 146 from where it may be conducted to a suitable reservoir.

A very similar structure is shown in FIG. 9. This structure is the same as that of FIGS. 7 and 8 with the exception that the nozzle 150 and the charging electrode 152 are extended, bent at a right angle and positioned for rotation in the space between the two deflecting electrodes 154. The nozzle 150 is directed backward with respect to the direction of rotation of

the nozzle. This construction adds to that of FIGS. 7 and 8 the further advantage that the relative velocity of the emitted ink droplets may be high with respect to the nozzle and low with respect to the deflecting electrodes, permitting high sensitivity to deflecting signals. Again, an ink collector ring 156 is positioned externally of the record receiving member 158 to catch any escaping ink droplets.

In FIG. 1 there is illustrated a means for introducing the varicosities into the stream of ink flowing from the nozzle which includes means for vibrating the nozzle itself. In FIGS. 2 and 2A there is shown a different means for accomplishing the varicosities in the issuing stream of ink through the introduction of internal stresses in the ink stream by the action of superimposed electric fields. In FIG. 10 there is illustrated still another means for effecting the varicosities in the issuing stream of ink. In the structure illustrated in FIG. 10 the varicosities are introduced by the introduction of variations in the pressure head of the ink supplied to the nozzle. The structure shown in FIG. 10 includes a nozzle 160 connected to a reservoir 162. The reservoir and the nozzle are supplied with ink under relatively high pressure through a feed pipe 164. One wall of the reservoir 162 includes a movable member such as diaphragm 166. The movable member or diaphragm 166 is mechanically connected to a electromechanical transducer 168 which constitutes a driver for the diaphragm 166. The driver 168 may be in the form of a magnetostrictive or piezoelectric transducer, or in the form of a dynamic moving coil transducer. As before the transducer may be energized from an exciting source of high-frequency signals 170, which signals alternate at the frequency necessary to produce the high rate of varicosity in the issuing ink stream. In operation ink is supplied through lead pipe 164 to the reservoir 162, filling the reservoir and the nozzle 160. The ink is supplied under the desired relatively high pressure as in the previously described structures. An alternating pressure wave is superimposed upon the pressure head of the ink supply by operation of the diaphragm 166 under the influence of the driver 168. The resulting variations in pressure produced the desired varicosities in the issuing stream of ink. These varicosities, as before, cause the issuing of ink to break up onto regularly spaced uniformly dimensioned discrete droplets.

It has been found, under certain conditions, that if all of the droplets issuing from the nozzle are allowed to strike the member, an indistinct image or trace would be produced because of an excessive amount of ink. Since the drop formation rate is primarily a function of the inherent mechanics of the system, including the mechanical characteristics of the ink supply itself, it would not be expedient nor practicable to produce a slower drop rate. Accordingly, there has been provided, in accordance with the present invention, means for intercepting a portion of the droplets on a controlled interval basis. The interception of the selected droplets may be accomplished by causing the selected droplets to be deflected from the normal recording path and to be directed to a suitable collector. This principle is illustrated in FIGS. 11, 12A, and 12B. In FIG. 11 there is shown a pair of wave trains representative of the signals applied to the system to accomplish the selective deflection and interception of the droplets. Curve A of FIG. 11 shows a series of pulses as applied to the droplet formation mechanism, each pulse representing a single droplet. Curve B is representative of a composite series of pulses applied to the droplet charging means, for example to the leads 172 and 174 of FIG. 12A. These leads are connected respectively to the nozzle 176, hence to the ink supply, and to the charging electrode 178. In the arrangement illustrated in FIGS. 11, 12A and 12B, one-third of the droplets are employed to record the applied intelligence signal. The remaining two-thirds are deflected and intercepted. In order to accomplish such a selection the signals applied to the droplet charging means must be synchronized with pulses applied to the droplet formation mechanism. Thus the pulses of Curve A are employed to trigger suitable pulse producing means such that during the interval of two adjacent pulses of Curve A, a bias signal of suitable polarity and magnitude is applied across the leads 172 and 174 such as to cause the selected droplets, under the influence of the electric field produced between the deflecting electrodes 175, to follow the trajectory 180. This path or trajectory, as shown in FIG. 12A, causes the selected droplets to be deflected into an opening in an intercepting receptacle 182. The receptacle 182 may be connected by a hose 184, or the like, to a suitable pump which returns the collected ink to the ink reservoir. During the interval of a signal pulse from Curve A, the intelligence signal representative of the data to be recorded is applied across the leads 172 and 174 instead of the fixed bias. The droplets that are charged during these signal droplet intervals are charged to a potential representative of the instantaneous value of the data or intelligence signal. These droplets are then directed toward the record member 186 along their individual trajectories within the envelope 188. As these droplets impinge upon the record member 186 they produce a record of the applied signal. The parameters of the system are so chosen that the fixed bias signal is of an absolute magnitude which is greater than the maximum data signal encountered. Thus, only the selected droplets corresponding to the intervals of fixed bias are deflected into the intercepting receptacle 182 and all of the droplets representative of data signals are permitted to strike the record member 186.

The apparatus shown in FIG. 12B is essentially the same as that shown in FIG. 12A with the exception of the intercepting means for the bias deflected droplets. Accordingly, corresponding parts are given reference numerals which correspond to those of FIG. 12A but with a prime superscript. Again, the signals corresponding to those illustrated in FIG. 11 are applied to the leads 172' and 174', connected, respectively, to the nozzle 176' and the charging electrode 178'. The bias signals cause the droplets to follow the trajectory 180', the path in which the droplets are intercepted. The intelligence signals cause the corresponding droplets to be directed toward the record member 186' along their individual trajectories within the envelope 188'. The structure illustrated in FIG. 12B differs from that of FIG. 12A in the nature of the deflecting electrodes and the intercepting collector. In FIG. 12B, one of the deflecting electrodes 190 may be the same as those heretofore described, a conventional metallic or conductive plate. The other electrode 192 is unique in that this electrode also serves as the intercepting collector for the bias charged droplets. To this end, the electrode 192 comprises a hollow shell member 194 made of an impervious conductive material such as brass or the like, and a face or cover member 196 made of a suitable porous material which is either inherently conductive or may be rendered conductive. The material of the face member 196 may be a porous ceramic which is normally nonconductive but which becomes conductive when it is wet by the conductive writing fluid. Alternatively, the face member 196 may be made of a porous metallic material such as sintered powdered metal, a substance which is inherently electrically conductive.

As the charged droplets are projected between the electrodes 190 and 192, those droplets charged in accordance with the bias signal are deflected by the electric field established between the electrode 190 and the electrode 192 to follow the trajectory 180'. In this path, the droplets impinge upon the surface of the porous face member 196. The chamber defined within the electrode 192 is maintained under at least a partial vacuum. Consequently, the droplets of writing fluid that impinge upon the porous face member 196 are drawn through that face member into the inner chamber. From the chamber within the electrode 192, the collected writing fluid is carried away through an exhaust line 198 and returned to a suitable reservoir.

In accordance with the system thus described, and assuming that the sampling ratio is as illustrated, every third droplet is charged in accordance with the desired data signal while the intervening two droplets are charged in accordance with the fixed bias signal and are deflected into the receptacle 182. It

will be appreciated, of course, that the system may be arranged to provide any desired ratio in the number of data droplets and to the number of selected intercepted droplets. For example, with a relatively slow speed of advancement of the record member 186, sampling rate for the data charged droplets might well be one per hundred, with 99 percent of the produced droplets charged in accordance with the fixed bias and deflected into the intercepting receptacle.

In the system illustrated in FIGS. 11, 12A, and 12B and described in connection therewith, the ratio of data charged droplets to the selected and intercepted droplets is constant. In FIG. 13 there is illustrated a circuit wherein the sampling rate, although still synchronized with the droplet forming signals, is variable in accordance with the rate of change of the data signal. This produces a constant intensity trace.

When the proportion of droplets deflected and intercepted as compared to those actually falling on the record member remain constant, as previously described, the trace appears to be of substantially uniform intensity so long as the input signal is constant or changes very slowly. When, however, a rapid change occurs in the signal, the signal trace is of less intensity during those intervals of rapid change, and, of greater intensity during intervals of slight or no change. Such a trace might, under some circumstances, result in a highly undesirable or even confusing record. In order to obviate such a condition, means are provided for controlling the delivery rate of the writing droplets in accordance with the rate of change of the signal to be recorded. The system illustrated in FIG. 13 provides means for so controlling the delivery rate of the writing droplets, those actually falling on the record member, that a minimum number of droplets are provided when the input signal is unchanging, then the droplet rate is increased in accordance with the derivative of the changing input signal. To this end, the input signal from the terminal 200 is applied to a phase inverter 202 whereby the input signal is divided into two channels such that positive going changes in the input signal produce a signal of the proper polarity in one of the channels and negative going changes in the input signal produce a signal of the same polarity in the other channel.

In the first channel, the output signal from the phase inverter 202 is applied to one electrode of a capacitor 204. The other electrode of the capacitor 204 is connected by a lead 205 to an amplifier 206. The output of the amplifier 206 is connected, through a diode 208 to an electronic switch 210. Similarly, in the second channel, the output signal from the phase inverter 202 is applied to one electrode of a capacitor 212. The other electrode of the capacitor 212 is connected, by a lead 213 to an amplifier 214. The output of the amplifier 214 is connected, through a diode 216, also to the input of the electronic switch 210. A constant current source 218 is connected to the lead 205. Similarly, a constant current source 220 is connected to the lead 213.

The electronic switch is of the type which is "normally open" until the control signal reaches a predetermined threshold value. At such time as the threshold value obtains, the electronic switch will be "closed," allowing applied signals to be passed through to subsequent equipment. In the instant case, the control signal applied to the electronic switch 210, is that signal derived from either of the two signal channels coupled to the output of phase inverter 202.

If the input signal applied to the phase inverter is constant, no signal resulting therefrom is transmitted, as a charge signal, across either of the capacitors 204 or 212. Under these conditions, the minimum control signal is developed by the current signal applied to the capacitors 204 and 212 from the constant current sources 218 and 220. The current from these sources provide a uniformly increasing charge to the capacitors 204 and 212. This, in turn, produces a signal of constant slope which is amplified by the amplifiers 206 and 214. If the amplifiers 206 and 214 are of the type which produce an output signal which is reversed in polarity from the input signal, then the signal applied to the input to the amplifier must be of opposite polarity to that required to turn the electronic switch 210 on. If it is assumed that an electrically positive signal is required to "close" the electronic switch, then the constant current sources 218 and 220 must supply a negative signal to the capacitors 204 and 212. As the capacitors 204 and 212 are charged by the current from the sources 218 and 220, respectively, the output signal from the amplifiers 206 and 214 increase until the threshold value or switching potential of the switch 210 is reached.

There is provided a source of trigger pulses 222 which pulses are synchronized with the droplet formation means associated with the nozzle. In other words, the source 222 provides a pulse of electrical energy for each droplet of writing fluid produced by the nozzle. This source 222 is connected to the electronic switch 210 so that when the switch 210 is "closed," the trigger pulses are passed to a pulse generator 224 connected to the output of the switch 210. The pulse generator 224 output is connected, first, to a pulse amplifier 226, the output of which is connected to a signal modulator 228. The output of the pulse generator 224 is also connected to a reset pulse generator 230. The output of the reset pulse generator 230 is connected, through a first diode 232, to the lead 205 and, through a second diode 234, to the lead 213. Additionally, a first clamping diode 236 is connected between the lead 205 and electrical ground and a second clamping diode 238 is connected between the lead 213 and ground.

When the switch 210 is "open" the trigger pulses from the source 222 are not passed to the pulse generator 224. When, however, the switch 210 has been "closed" by the control signal, the next trigger pulse from the source 222 is applied to the pulse generator 224. The generator 224 produces a pulse which is substantially a square wave in shape and of just sufficient width to charge a single droplet. That pulse is then amplified by the amplifier 226 and applied to the modulator 228. The output pulses from the generator 224 are also applied as input signals to the reset pulse generator 230. THe generator 230 may be in the form of a differentiator to produce a sharp pulse coincident with the leading edge of each of the pulses produced by the generator 224. These sharp pulses are then applied, through the diodes 232 and 234, respectively, to return or reset the capacitors 204 and 212 to zero. The resetting of the capacitors 204 and 212 to zero causes the electronic switch to be again "opened." Thus, a single trigger pulse from the source 222 is passed by the switch 210 each time the switch is "closed." Each time the capacitors 204 and 212 are reset to zero, they immediately begin to charge again since the constant current sources 218 and 220 continue to the repetition rate of the closing of the switch 210 depends on the charging rate of either of the capacitors.

The output of the modulator is connected to the charging electrode associated with the nozzle, such as the electrode 178' of FIG. 12B. The modulator 228 provides an output signal which, in the absence of a modulating signal, biases the charging electrode such that the droplets will all be deflected to be intercepted by the intercepting means. The signals from the pulse generator 224, amplified by the amplifier 226, are of such a magnitude and polarity that, in the absence of a modulating signal, they would cause the selected droplets to be charged to such a value that the droplets would be deflected to a maximum deflection away from the intercepting means. However, the signal input terminal 200 is also connected to the modulator 228 as a modulating input signal. Thus, the pulse signals from the pulse amplifier 226 are amplitude modulated by the input signal from the terminal. If, as has been assumed thus far, the input signal is unchanging, the repetition of the pulses from the pulse generator 224, hence the droplet selection rate, will be determined by the rate at which the capacitors 204 and 212 are charged, respectively, by the constant current sources 218 and 220. The deflection of these droplets, or relative location of the resultant trace on the record member, will be dependent upon the magnitude of the signal applied from the terminal 200.

If, now, the signal appearing at the terminal 200 should be a changing signal, the change would reflect on the charging rate

of one or the other of the capacitors 204 and 212. If, for example, the change is a positive change, i.e. an increasing signal, the charging rate of the capacitor 204 is increased in proportion to the rate of increase of the input signal. The threshold level or switching potential of the electronic switch is reached at a time earlier than heretofore described by an amount which is proportional to the rate of increase of the input signal. Thus, the repetition rate of the droplet selection is increased by an amount which is proportional to the rate of change of the input signal. Accordingly, the net droplet selection is at a rate which is proportional to the first derivative of the incoming signal plus a constant, the constant being that supplied by the constant sources and may be related to the velocity of the record member.

The increasing signal which produced a change in the charging rate of the capacitor 204, would have no effect on the capacitor 212 since it would appear as an opposite polarity signal across that capacitor and the clamping diode 238 prevents that capacitor from being oppositely charged.

If, on the other hand, the incoming signal changes negatively, i.e. a decreasing signal, the capacitor 212 has its charging rate increased, producing an identical effect on the switching rate of the electronic switch 210. Under this condition, the clamping diode 236 prevents the capacitor 204 from being reversely charged.

The system described and illustrated in FIG. 13 provides means for controlling the repetition rate of the writing droplets in accordance with the absolute rate of change of the input signal, without regard to the direction of change in the signal, thereby producing on the record member a substantially constant intensity trace.

Thus, it may be seen that there has been provided, in accordance with the present invention, a graphic recorder for the direct writing of signal information which may cover a wide band of signal frequencies, and in which the direct recording is accomplished without the necessity of physical contact between the writing instrument and the record receiving member.

I claim:

1. A method of making records on a record member by use of fluid droplets, comprising the steps of supplying writing fluid to a nozzle under pressure whereby a stream of writing fluid is projected toward the record member, applying cyclically varying energy at a predetermined frequency to the writing fluid to cause the stream issuing from the nozzle to break up into a succession of separate evenly spaced uniform droplets which move in free flight and initially in single file toward the record member, causing the stream adjacent to the nozzle to pass adjacent to a charging electrode, applying variable electrical signal values representative of the desired deflections to the charging electrode whereby individual droplets are electrostatically charged to effect different charges on at least some droplets of the succession, causing the droplets thereafter to pass in proximity to a deflecting electrode, applying a potential to the deflecting electrode to produce an electrostatic deflecting field through which the droplets pass whereby charged droplets are deflected laterally, with droplets having different charges moving through different trajectories, causing relative movement between the record member and the nozzle, and causing at least some of the droplets passing through said deflecting field to be deposited on the record member to make a record thereon.

2. A method as in claim 1 in which the electrical signal values applied to the charging electrode are correlated with the cyclically varying energy applied to the fluid.

3. A method as in claim 2 in which selected droplets are intercepted and thereby not deposited on the record medium.

4. A direct writing recorder comprising means for projecting a stream of writing fluid in the form of a single file succession of spaced discrete droplets toward the surface of a record receiving member, means for supporting a record receiving member and for effecting relative movement between the same and said projecting means, means for electrostatically charging said discrete droplets in accordance with the instantaneous values of a variable signal input to effect different charges on at least some droplets of the succession, and electrostatic means for deflecting said discrete droplets in accordance with the charges carried by said droplets during the flight of said droplets between said projecting means and said record receiving member, with droplets having different charges being deflected to take different trajectories, said droplets being deposited on the surface of the record member to produce a record that is characterized by the signal variations.

5. A direct writing recorder as in claim 4 in which said droplets are formed at a predetermined rate, together with bias signal means coupled to said electrostatic charging means for placing a predetermined bias charge on selected droplets, said bias means including synchronization means for synchronizing said droplet selection with said droplet formation rate.

6. A direct writing recorder as in claim 5 in which said synchronization means causes at least two adjacent ones of said droplets to be successively charged in accordance with said input signal and with said bias charge.

7. A direct writing recorder as in claim 5 in which the magnitude of said bias signal is distinct from the range of magnitudes of said input signal whereby bias charged droplets follow a trajectory substantially different from trajectories followed by droplets charged in accordance with said input signal.

8. A direct writing recorder as in claim 7 together with intercepting means located in said trajectory of said bias charged droplets for preventing such droplets from striking said record receiving members.

9. Apparatus as in claim 5 together with means for intercepting said selected droplets.

10. A direct writing recorder comprising means for projecting a stream of writing fluid in the form of a single file succession of spaced discrete droplets toward the surface of a record receiving member, means for supporting a record receiving member and for effecting relative movement between the same and said projecting means, means for electrostatically charging said discrete droplets in accordance with the instantaneous values of a variable signal input to effect different variable on at least some of the droplets of the succession, a pair of electrostatic deflecting electrodes positioned, respectively, on opposite sides of said stream of droplets, and means for applying a constant unidirectional electrostatic charge to said deflecting electrodes to produce a constant electric field therebetween whereby to deflect the path of said discrete droplets in their course between said projecting means and said record receiving member in accordance with the charges carried by said discrete droplets, with droplets having different charges being deflected to take different trajectories, said droplets being deposited on the surface of the record member to produce a record that is characterized by the signal variations.

11. A direct writing recorder comprising means for projecting a stream of writing fluid toward a record receiving member, means for supporting a record receiving member and for effecting relative movement between the same and said projecting means, means for introducing regularly spaced variations in the stream of said writing fluid to assure the formation of a succession of discrete droplets of uniform dimension at a constant rate, means for electrostatically charging said discrete droplets in accordance with the instantaneous values of a variable signal input to effect different charges on at least some droplets of the succession, a pair of electrostatic deflecting electrodes positioned, respectively, on opposite sides of said stream of droplets, and means for applying a constant unidirectional electrostatic charge to said deflecting electrodes to produce a constant electric field therebetween whereby to deflect the path of said droplets in their course between said projecting means and said record receiving member in accordance with the charges carried by said dis-

crete droplets, with droplets having different charges being deflected to take different trajectories, said droplets being deposited on the surface of the record member to produce a record that is characterized by the signal variations.

12. The invention as set forth in claim 11 wherein said means for introducing said varicosities in said stream comprises electromechanical vibrating means mechanically coupled to vibrate said nozzle, and means for exciting said vibrating means at the desired formation rate.

13. A direct writing recorder comprising, in combination, means for projecting a stream of writing fluid toward a record receiving member including a nozzle, means for supporting a record receiving member and for effecting relative movement between the same and said projecting means, a feed pipe connected to said nozzle for supplying writing fluid thereto, and means for establishing a substantial pressure head on said fluid in said feed pipe, means for introducing regularly spaced varicosities in the stream of said writing fluid to assure the formation of a succession of discrete droplets of uniform dimension and at a constant rate, means for electrostatically charging said discrete droplets in accordance with the instantaneous values of a variable signal input to effect different charges on at least some droplets of the succession, a pair of electrostatic deflecting electrodes positioned, respectively, on opposite sides of said stream of droplets, and means for applying a constant unidirectional electrostatic charge to said deflecting electrodes to produce a constant electric field therebetween whereby to deflect the path of said droplets in their course between said nozzle and said record receiving member in accordance with the charges carried by said discrete droplets, with droplets having different charges being deflected to take different trajectories, said droplets being deposited on the surface of the record member to produce a record that is characterized by the signal variations.

14. The invention as set forth in claim 13 wherein said means for introducing said varicosities in said stream comprises an electrode positioned adjacent said nozzle and surrounding said stream and means for establishing an oscillatory electrostatic field between said stream and said electrode.

15. The invention as set forth in claim 13 wherein said means for introducing said varicosities in said stream comprises means for vibrating said nozzle.

16. The invention as set forth in claim 15 wherein said vibrating means comprises an electromechanical transducer.

17. The invention as set forth in claim 15 wherein said vibrating means comprises a magnetostrictive driving element mechanically coupled to said feed pipe and means for exciting said magnetostrictive element at the desired formation rate.

18. The invention as set forth in claim 13 wherein said means for charging said droplets comprises a charging electrode spaced slightly from said nozzle and surrounding said stream at the point of the formation of said droplets, and means for applying a charging signal between said fluid and said charging electrode.

19. The invention as set forth in claim 13 and characterized by the addition of means for introducing a laminar flowing stream of air into the area embracing said stream of droplets whereby to reduce interaction between successive droplets.

20. The invention as set forth in claim 19 wherein said stream of air is collinear with said stream of droplets.

21. The invention as set forth in claim 19 wherein said stream of air is perpendicular to said stream of droplets.

22. The invention as set forth in claim 13 wherein said record receiving member defines a cylindrical surface for the reception of said ink droplets, said deflection electrodes are in the form of a pair of flat, parallel toroids, and means are provided for rotating said nozzle about the axis of said cylindrical surface whereby said stream of droplets define a substantially circular trace about said axis.

23. A direct writing recorder as in claim 13 wherein said means for introducing varicosities in said stream comprises means for introducing superimposed fluctuations in the established pressure head on said fluid, said fluctuations being at the desired rate of formation.

24. A direct writing recorder comprising, in combination, means for projecting a stream of writing fluid toward a record receiving member including a nozzle, a feed pipe connected to said nozzle for supplying writing fluid thereto, and means for establishing a substantial pressure head on said fluid in said feed pipe, electromechanical vibrating means for vibrating said nozzle to introduce regularly spaced varicosities in the issuing stream of said writing fluid to assure the formation of a succession of discrete droplets of uniform dimension and at a constant rate, means for exciting said vibrating means at the desired formation rate, a charging electrode positioned adjacent said nozzle and surrounding the path of said stream, means for applying a charging signal between said fluid and said charging electrode whereby to electrostatically charge said discrete droplets in accordance with the instantaneous values of an input signal, a pair of electrostatic deflecting electrodes positioned, respectively, on opposite sides of said stream of droplets, means for applying a constant unidirectional electrostatic charge to said deflecting electrodes to produce a constant electric field therebetween whereby to deflect the path of said droplets in their course between said nozzle and said record receiving member in accordance with the charges carried by said discrete droplets, guide means for guiding said record receiving member in a position to receive said stream of droplets, and record receiving member driving means for driving said record receiving member through said guide means.

25. A direct writing recorder comprising means for projecting a stream of writing fluid toward a record member, means for introducing regularly spaced varicosities in the stream of said fluid to assure the formation of droplets of uniform dimension and at a constant rate, means for electrostatically charging selected ones of said discrete droplets in accordance with the instantaneous values of a signal input, means for causing the remainder of said discrete droplets to have a common charge value, a pair of electrostatic deflecting electrodes positioned, respectively, on opposite sides of said stream of droplets, means for applying a constant unidirectional electrostatic charge to said deflecting electrodes to produce a constant electric field therebetween whereby to deflect the path of said droplets in their course between said projecting means and said record receiving member in accordance with the charges carried by said discrete droplets, and means for intercepting those droplets having said common charge value.

26. The invention as set forth in claim 25 wherein said intercepting means comprises a receptacle positioned adjacent the path of said droplets and into which the common charge value droplets are directed.

27. The invention as set forth in claim 25 wherein said intercepting means includes one of said deflecting electrodes, said one of said electrodes comprising a hollow shell member formed of impervious conductive material and a face member formed of material which is pervious to the writing fluid and onto which the common charge value droplets impinge and means for drawing the intercepted droplets through said pervious member into said hollow shell member.

28. The invention as set forth in claim 25 wherein the ratio of the number of said selected droplets to the number of the common charge value droplets is a predetermined fixed ratio.

29. The invention as set forth in claim 25 wherein the ratio of the number of the selected droplets to the number of the common charge value droplets is a function of the rate of change of the signal input.

30. A direct writing recorder comprising means for projecting a stream of writing fluid in the form of a single file succession of spaced, discrete droplets toward the surface of a record receiving member, means for supporting a record receiving member and for effecting relative movement between the same and said projecting means, means for characterizing said discrete droplets in accordance with the instantaneous values of a variable signal input to effect different characterizations on at least some droplets of the succession, and means for deflecting said discrete droplets in accordance with the characterizations of said droplets during the

flight of said droplets between said projecting means and said record receiving member, with droplets having different characterizations being deflected to take different trajectories, said droplets being deposited on the surface of the record member to produce a record that is characterized by the signal variations.

31. A direct writing recorder as in claim 30 in which the means for characterizing the discrete droplets consists of means for electrostatically charging the droplets and in which the means for deflecting the discrete droplets consists of means forming an electrostatic field through which the droplets are projected.

32. A direct writing recorder as in claim 31 together with a droplet interceptor disposed whereby predetermined ones of the droplets that are so characterized are projected toward and intercepted by the same.

33. Liquid droplet recording apparatus comprising, means for forming a fluid jet by supplying fluid to an orifice at a pressure sufficient to cause fluid to issue from the orifice as an unsupported stream, means for providing periodic varicosities in said jet to cause it to divide at predetermined intervals into a single file succession of discrete droplets, means for establishing a droplet charging electric field at the region of said fluid jet where said drop division occurs including means for varying said electric field with time as a function of the instantaneous values of a variable signal input to charge the droplets in accordance with said instantaneous values to effect different charges on at least some droplets of the succession, means for establishing a deflecting electric field in a region traversed by said droplets for causing said drops so charged to follow trajectories that are a function of the amount of charge on said droplets, and means for collecting said droplets, said last means serving to collect droplets having different trajectories in different regions.

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No. 83-698

IN THE

Supreme Court of the United States

OCTOBER TERM, 1983

BURROUGHS CORPORATION,
Petitioner,

vs.

A. B. DICK COMPANY,
Respondent.

REPLY BRIEF FOR PETITIONER

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Appendix H

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IN THE

Supreme Court of the United States

OCTOBER TERM, 1983

BURROUGHS CORPORATION,

Petitioner,

vs.

A. B. DICK COMPANY,

Respondent.

REPLY BRIEF FOR PETITIONER[1]

Since the filing of respondent's brief in opposition to the petition, the Court of Appeals for the Sixth Circuit has affirmed the District Court's judgment in the *Mead* case, on which petitioner has relied for collateral estoppel. *Mead Digital Systems, Inc.* v. *A. B. Dick Co.*, 521 F.Supp. 164 (S.D. Ohio 1981), *aff'd*, —— F.2d —— (6th Cir. 1983) (not yet reported). A copy of the opinion of the Court of Appeals is attached hereto as a Supplemental Appendix, designated Appendix H, starting at page A123.

In its brief, respondent asserts that the ruling in the *Mead* case on the scope of the Sweet patent in suit, to which petitioner ascribes preclusive effect, was dicta; that the *Mead* court lacked the power to adjudicate the Sweet patent's scope, except in the context of the accused machines before that court; and that the claims of a patent must be consulted to determine its scope.

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[1] All parent companies, subsidiaries and affiliates of petitioner, Burroughs Corporation, were listed on page ii of the petition. There have been no changes since the petition was filed.

In support of these assertions, respondent argues (1) that while petitioner discusses "the issue of scope", the abstract scope of a patent claim can never be anything but hypothetical; (2) that petitioner has avoided discussing the constitutional ban on hypothetical questions and advisory opinions; and (3) that it is fundamental that the claims of a patent must control the question of infringement. We will reply to these arguments in sequence.

I. Mead Judgment

Respondent's characterization of the *Mead* court's declaratory judgment defining the scope of the Sweet patent as "dicta" cannot impugn the essential nature of that ruling for collateral estoppel purposes. As discussed in the petition, the issue of scope was pleaded in the *Mead* declaratory judgment action, preserved in the final pretrial order, tried, briefed and decided by a declaration in the final judgment[2] (A 65-6, 68, 83).

The attached opinion of the Court of Appeals quotes the final judgment of the *Mead* District Court in full, including the declaration that:

> "The Sweet patent is limited in scope to oscillographic recording." (A125).

Further, the court observed that the parties to the *Mead* suit had advised the court that its decision will control the interpretation of key patents in the expanding ink jet

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[2] This is in contrast to the ruling on scope involved in *Studiengesellschaft Kohle* v. *Eastman Kodak Co.*, 616 F. 2d 1315 (5th Cir. 1980), *cert. denied*, 449 U.S. 1014 (1980), relied upon by respondent. In that case, the prior ruling on scope was at most a finding, or perhaps an incidental statement, not embodied in the final judgment. *Ziegler* v. *Phillips Petroleum Co.*, 483 F. 2d 858 (5th Cir. 1973), *cert denied*, 414 U.S. 1079 (1973). Further, the court found that it was not essential to what was embodied in the final judgment. Thus, the court correctly ruled that the finding was not entitled to preclusive effect.

printing industry. A124. With this in mind, the court affirmed the District Court's judgment. (A126, 143).

Also, with regard to the relevance of the scope holding by the *Mead* District Court to its determination of non-infringement, the opinion states that:

> "The District Court rested its determination of non-infringement largely on the grounds that the Sweet patent is limited to oscillography—the recording of waveforms of electrical signals." (A125).[3]

In summary, the *Mead* court's ruling on scope is itself a final judgment entitled to collateral estoppel effect. That ruling was pleaded, tried and finally decided, and its determination was essential to Mead's demand for a declaration of the scope of the Sweet patent—entirely apart from considerations of validity or infringement. The issue of scope was, however, also an essential element of the *Mead* court's ruling on both validity (i.e., valid "as so construed") and infringement. (A80, 125).

II. Constitutional Jurisdiction

Respondent's characterization of the scope of a patent as always being hypothetical is without the citation of authority, or reason. It is an everyday task of a patent lawyer to advise clients what they are free to do in view of a competitor's patents. If that advice is acted upon, in any substantial measure, and that action challenged by the patent-holder, it is difficult to see how any issue could be more immediate and concrete. *Cf. Super Products Corp.* v. *D P Way Corp.*, 546 F.2d 748, 752-5 (7th Cir. 1976);

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[3] The court noted the rulings of the District Court and the CAFC in this case, and disagreed with the CAFC finding that the District Court's infringement ruling in *Mead* was based solely upon the direction of the droplet deflection, rather than the cumulative differences that distinguished between oscillography and character printing. (A128-129).

Rengo Co. Ltd. v. *Molins Machine Co.*, 657 F.2d 535, 538-40 (3d Cir. 1981).[4]

Equally important to this case, however, is the fact that the *Mead* court decided its own jurisdiction, and that decision is entitled to collateral estoppel effect. (A65-81). *Underwriters Assur. Co.* v. *North Carolina Life*, 455 U.S. 691, 706 (1982); *Stoll* v. *Gottlieb*, 305 U.S. 165 (1938); *Restatement Second of Judgments*, 1982, § 12, espec. comments c. and d. Therefore, respondent's arguments based upon the hypothetical nature of the scope issue, and the consequent absence of constitutional jurisdiction, are misplaced. Respondent's avenue of review of the *Mead* court's

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[4] Respondent asserts that even after a court has defined the metes and bounds of a patent claim, it still cannot decide a case for a plaintiff or defendant until it has determined whether the specific accused device is within those metes and bounds (R. Br., pp. 7-8). It is not clear how this circumstance, where it is true, can make the scope of a patent a non-issue. Nor is it clear why a licensee or prospective manufacturer cannot seek a declaration of the scope of a patent, without including the issues of validity or infringement, where circumstances warrant, or why a determination of validity or infringement cannot be accompanied by a determination of scope that is as definitive as the facts permit, to avoid unnecessary repetitive litigation and to provide some guidance for future decisions. This is particularly true, where, as here, the patentee's representations to the Patent Office, and amendments to the claims, estop him from construing the claims to cover anything other than the declared scope. *Mead*, Conclusion 153. (A 59).

To be sure, the issue of scope, just as the issue of validity, or any other, may in a particular case lack sufficient immediacy and reality to be justiciable. *Dr. Beck & Co. G.m.b.H.* v. *General Electric Company*, 317 F.2d 538 (2d Cir. 1963); *K-Jack Engineering Co.*, v. *Pete's Newsrack, Inc.*, 205 U.S.P.Q. 696, 697 (C.D. Cal. 1978); *cf. Underwriters Assur. Co.* v. *North Carolina Life*, 455 U.S. 691, 706 (1982); *Stoll* v. *Gottlieb*, 305 U.S. 165 (1938); *and cf. Golden* v. *Zwickler*, 394 U.S. 103 (1969) (cited by respondent). These cases cannot, however, undermine a federal court's jurisdiction to determine the scope of a patent where that issue is being disputed between two competitors, and where the issue is both immediate and real.

jurisdiction determination was through an appeal in that case, and a petition to this Court. Only havoc will result from permitting a foreign court to refuse preclusive effect to a final determination by the vehicle of questioning the jurisdictional premise for the determination, when the jurisdictional ruling is itself entitled to preclusive effect.

III. Patent Claims

With regard to respondent's assertion that the claims of a patent are determinative of its scope, and controlling as to the question of infringement, while this is true, once the scope of the claims has been resolved, such as by the final judgment entered in the *Mead* case, that issue need not be relitigated.

A determination of infringement is generally a two-step process, namely, first determining the scope of the claims, and, secondly, determining whether the accused device falls within that scope. *Westinghouse* v. *Boyden Power Brake Co.*, 170 U.S. 537, 568 (1898); *Graver Tank & Mfg. Co.* v. *Linde Air Products Co.*, 339 U.S. 605, 608-09 (1950);[5] *Autogiro Company of America* v. *United States*, 384 F.2d 391, 401 (Ct. Cl. 1967), *cert. denied sub nom. United States* v. *Pitcairn*, 434 U.S. 1051 (1978). Here, as noted, the Sweet patent's scope was resolved by the declaratory judgment in the *Mead* case. The District Court in the present case correctly found that the sole remaining issue concerning infringement is whether the accused devices fall within the adjudicated scope. Also, the court correctly found, on the basis of undisputed facts, that the accused devices do not fall within that scope and, consequently, that no infringement exists.

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[5] Respondent cited one side of the coin from this Court's opinion in *Graver*, concerning literal infringement, but not the other, which followed *Westinghouse* v. *Boyden*, *supra*. *See* 339 U.S. at 608-9. This is discussed in the attached Court of Appeals opinion. (A134-137).

Conclusion

The unsettling effect of the CAFC decision in this case, both on this case and on the administration of justice in our courts, should not be permitted to stand. Certiorari should be granted for the fundamentally important issues projected by this case.

Date:

Respectfully submitted,

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SUPPLEMENTAL APPENDIX

Appendix H.

Appendix H

RECOMMENDED FOR FULL-TEXT PUBLICATION
See, Sixth Circuit Rule 24

Nos. 82-3163
82-3178

UNITED STATES COURT OF APPEALS

FOR THE SIXTH CIRCUIT

MEAD DIGITAL SYSTEMS, INC.; MEAD CORPORATION,
Plaintiff-Appellee, (82-3163)
Defendant-Appellee, (82-3178)
Cross Appellant,

v.

A.B. DICK COMPANY and GOULD, INC.,
Defendants-Appellants, (82-3163)
Plaintiffs-Appellants, (82-3178)
Cross Appellees.

ON APPEAL from the United States District Court for the Southern District of Ohio.

Decided and Filed December 8, 1983.

Before: KEITH and MERRITT, Circuit Judges; WISEMAN,* District Judge.

MERRITT, Circuit Judge. This patent infringement case concerns a new form of printing whereby printer's ink is guided

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* The Honorable Thomas A. Wiseman, Jr., Judge of the United States District Court for the Middle District of Tennessee, sitting by designation.

onto paper or other recording media by electrical charges applied to ink streaming from small nozzles, rather than by conventional type, press, pen or other contact. The process, called "ink jet printing," is now used by businesses which require high speed printing or printing on soft or other unusual surfaces. Ink jet printers are particularly well-suited for computer print-outs and labeling. The parties to this action advise us that ink jet printing may be the "wave of the future" and that our decision in the case will control the interpretation of key patents in this expanding industry.

A.B. Dick Company ("A.B. Dick"), the owner of the "Sweet" patent, U.S. Patent No. 3,966,275 issued on July 27, 1971, and the exclusive licensee under the "Lewis-Brown" patent, U.S. Patent No. 3,298,030 issued on January 10, 1967, and Gould, Inc. ("Gould"), the owner of the Lewis-Brown patent, assert that the DIJIT printer, manufactured by the Mead Corporation ("Mead"), infringes these two patents. In a well-considered opinion, District Judge Walter Rice[1] concluded *inter alia* that the Lewis-Brown patent is invalid and that the DIJIT printer does not infringe the Sweet patent.[2] *Mead Digital Systems, Inc.* v. *A.B. Dick Co.*, 521 F.Supp. 164 (S.D. Ohio 1981).

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[1] A.B. Dick and Gould originally filed a complaint alleging infringement against the Mead Corporation and Mead Data Central, Inc., in the United States District Court for the Northern District of Illinois. Shortly thereafter, Mead Digital Systems, Inc., a subsidiary of The Mead Corporation, filed a declaratory judgment action against A.B. Dick and Gould in the United States District Court for the Southern District of Ohio, Honorable Walter H. Rice, presiding. The action in Illinois was dismissed as against Mead Data Central Inc., and the remainder of the Illinois case was, with the consent of all the parties, transferred to the Southern District of Ohio where it was consolidated with the declaratory judgment action. By consent of the parties, A.B. Dick and Gould are referred to as plaintiffs and Mead as defendant.

[2] The final judgment of the District Court, filed on January 26, 1982, contained the following:

> It is Ordered, Adjudged, and Declared:
>
> 1. Mead's Dijit printer does not infringe Sweet Patent No. 3,596,275.

The District Court rested its determination of non-infringement largely on the grounds that the Sweet patent is limited to oscillography – the recording of waveforms of electrical signals. Appellants strongly contest this construction of the Sweet patent. While conceding that the illustrative embodiments of the patent depict only oscillographs, they argue that claims 1[3] and 33[4] of the Sweet patent, the claims in issue,

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2. The Sweet patent is limited in scope to oscillographic recording.

3. The Sweet patent is valid.

4. Mead's Dijit printer does not infringe Lewis-Brown Patent No. 3,298,030.

5. The Lewis-Brown patent is limited in scope to printing of characters with charged droplets that are deflected transverse to the relative movement between the paper and nozzle.

6. The Lewis-Brown patent is invalid.

7. A.B. Dick and Gould are not precluded from prosecuting the patent infringement action by reason of laches.

8. A.B. Dick and Gould shall take nothing, and the patent infringement actions by their complaint and counterclaim are dismissed on the merits.

9. The Mead Corporation and Mead Digital Systems shall recover of A.B. Dick and Gould their costs of the actions.

[3] Claim I of the Sweet patent claims:

A method of making records on a record member by use of fluid droplets, comprising the steps of supplying writing fluid to a nozzle under pressure whereby a stream of writing fluid is projected toward the record member, applying cyclically varying energy at a predetermined frequency to the writing fluid to cause the stream issuing from the nozzle to break up into a succession of separate evenly spaced unform droplets which move in free flight and initially in single file toward the record member, causing the stream adjacent to the nozzle to pass adjacent to a charging electrode, applying variable electrical signal values representative of the desired deflections to the charging electrode whereby individual droplets are electrostatically charged to effect different charges on at least some drop ets of the succession, causing the droplets thereafter to pass in proximity to a deflecting electrode, applying a potential to the deflecting electrode to produce an electrostatic deflecting field through which the droplets pass whereby charged droplets are deflected laterally, with droplets having different charges moving through different trajectories, causing relative movement between the record member and the nozzle, and causing at least some of the droplets passing through said deflecting field to be deposited on the record member to make a record thereon.

[4] Claim 33 of the Sweet patent claims:

Liquid droplet recording apparatus comprising, means for form-

disclose a method and apparatus for recording a wide variety of images, including alphanumeric characters.

In order to prevail on this issue, appellants, as we see it, must satisfactorily answer two related questions. First, if the Sweet patent contemplated calligraphy as well as oscillography and in application could compose characters as well as curved lines, why does not the patent say so directly and explain the process unambiguously? Why is this claim left unclear if it was intended? Second, if the Sweet patent claimed high speed character writing and needed no significant improvement or fundamental change to do so, why did Sweet join with Dr. Cumming, his supervisor, in subsequently filing a second, separate patent application disclosing a more advanced multiple ink jet system clearly designed for high speed character writing?

Appellants have failed to answer these questions satisfactorily and have failed to carry their burden of proof on the issues. The Mead DIJIT printer, which is based on the very patent application filed by Sweet with his supervisor after the original Sweet application was filed, is a substantial improvement over the invention disclosed in the Sweet patent.

Since we also agree with the District Court that the Lewis-Brown patent is invalid for obviousness, we affirm.

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ing a fluid jet by supplying fluid to an orifice at a pressure sufficient to cause fluid to issue from the orifice as an unsupported stream, means for providing periodic varicosities in said jet to cause it to divide at predetermined intervals into a single file succession of discrete droplets, means for establishing a droplet charging electric field at the region of said fluid jet where said drop division occurs including means for varying said electric field with time as a function of the instantaneous values of a variable signal input to charge the droplets in accordance with said instantaneous values to effect different charges on at least some droplets of the succession, means for establishing a deflecting electric field in a region traversed by said droplets for causing said drops so charged to follow trajectories that are a function of the amount of charge on said droplets, and means for collecting said droplets, said last means serving to collect droplets having different trajectories in different regions.

I. THE PATENTS IN ISSUE AND THE ACCUSED DEVICE

A. The Art Prior to Sweet

Many large and small steps of discovery in physics and electricity from the Nineteenth Century forward have led to the modern practice of ink jet printing. These steps include Michael Faraday's experiments in 1831 in electromagnetic induction and Lord Rayleigh's discovery in 1897 that a stream of liquid droplets issuing from a nozzle can be made uniform in size and spacing by applying cyclic energy or vibrations to the droplets as they form at the nozzle orifice.

C. R. Winston was the first person to incorporate these longstanding discoveries into a commercially successful ink jet printer. His device, patented in 1962 (U.S. Patent No. 3,060,429) and marketed as the Teletype Inktronic, recorded information by forming a single-file train of ink droplets that were imprinted with a uniform electrical charge. The droplets were directed between a pair of "deflection plates" which received variable electrical signals from an input source. The interaction of the constant charge placed on the droplet with the variable charge placed on the deflection plates caused the droplets to be deflected, the magnitude and direction of deflection depending on the charge placed on the deflection plates. After leaving the deflection field, the droplets travelled along their programed trajectories to a recording medium, usually paper, that passed under the nozzle and deflecting apparatus.

Although the Winston device was able to print alphanumeric characters, it could operate only at relatively slow speeds, since only one droplet could be present in the deflection field at a time. If a trailing droplet entered the deflection field before the leading droplet exited, the trailing droplet would be deflected along the identical trajectory as the leading drop-

let, since all droplets received identical charges and their trajectories were determined by the charge placed on the deflection plates when the droplets were present in the deflection field.

B. The Sweet Patent

In 1961 Richard G. Sweet, then an electrical engineer conducting research at Stanford University, received as a gift an aquarium equipped with a device that sent bubbles through the water to provide oxygen to the inhabitants of the aquarium. Sweet's scientific curiosity got the best of him, and he set out to determine how oxygen was transferred from the bubbles to the water. The pursuit of this inquiry led eventually to U.S. Patent No. 3,966,275, the Sweet patent, by all accounts a monumental step in the march toward commercial application of ink jet printing concepts.

The apparatus disclosed in Sweet's patent controlled the trajectory of the ink droplets by maintaining a constant voltage on the deflection plates and placing a variable voltage on the droplets, the opposite of the system used by Winston. Attached as Appendix A is one of the illustrative embodiments included in the Sweet patent. This arrangement permitted Sweet's device to operate much faster than Winston's; several droplets, each encoded with its own "signal" charge, could be present in the constantly-charged deflection field at the same time. Indeed, the operational speed of Sweet's device was limited only by the rate at which the droplets could be formed. Sweet found that he could generate as many as 120,000 droplets per second, resulting in a recording speed hundreds of times faster than the Winston device could achieve.

The parties have paid particular attention to the direction of deflection disclosed in the Sweet patent.[5] Claim 1 of the

[5] In a separate infringement action initiated by A.B. Dick against the Burroughs Corporation wherein A.B. Dick alleges that a machine

patent teaches that "charged droplets are deflected laterally" while claim 33 discloses an apparatus for causing charged droplets "to follow trajectories that are a function of the

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marketed by Burroughs infringes the Sweet patent, the United States District C urt for the Northern District of Illinois held that the District Court's holding in the instant case collaterally estops A.B. Dick from arguing that the Sweet patent extends beyond oscillography. *A.B. Dick Company* v. *Burroughs Corporation*, 550 F.Supp. 1065 (N.D. Ill. 1982). That decision was appealed to the United States Court of Appeals for the Federal Circuit, which held that collateral estoppel was not appropriate in that case. *A.B. Dick Company* v. *Burroughs Corporation*, 713 F.2d 700 (Fed. Cir. 1983). In reaching its decision, the Federal Circuit stated that the

> Mead court held, on the basis of claim interpretation, that the DIJIT printer did not infringe because it did not deflect droplets transversely of the relative direction of movement between the paper and the nozzle.

713 F.2d at 703.

We do not agree that the District Court below rested its holding of non-infringement solely on the different deflection directions used in the two machines. While the District Court did pay particular attention to the different deflection directions used in the Sweet device and the DIJIT printer, it also pointed to the following differences between the two machines:

> (i) each orifice in the DIJIT is incapable of producing either a continuous waveform characteristic of a variable signal or common alphanumeric or geometric configurations, 521 F.Supp. at 179;
>
> (ii) the final picture produced by the DIJIT printer is alphanumeric or graphic information which is not characteristic of the charging signals to the charging tunnels, *Id.*;
>
> (iii) the interception facility in the Sweet device does not serve the purpose of creating an apparent discontinuity in any portion of the waveform, but only to adjust the density of the waveform by increasing the distance between droplet imprints, 521 F. Supp. at 173-74.

The District Court's holding, as we read it, is based on the cumulative effect of these differences. While the court did appear to rest its decision that the DIJIT printer does not *literally* infringe the Sweet patent primarily on the difference in deflection direction, its holding that the DIJIT printer is not an equivalent of the Sweet device was, in our view, based on factors in addition to the different deflection angle used in the two machines. As we discuss *infra*, pp. 12-15, a finding of literal infringement is not determinative in infringement cases: the court must ultimately apply the doctrine of equivalents, which the District Court did. 521 F.Supp. at 184.

amount of charge on said droplets."[6] The District Court concluded that these claims are ambiguous in that the terms "laterally" and "trajectories" are meaningless without a reference plane. 521 F.Supp. at 174. The District Court resolved this perceived ambiguity by examining the illustrative embodiments, specifications, and the prosecution history of the patent and, on the basis of this examination, concluded that the claims disclose only deflection in a direction transverse to the movement of the recording medium relative to the nozzle. *Id.*

Appellants vigorously dispute this conclusion. They argue that the term "laterally" in claim 1 means "laterally to the initial droplet direction" and that the term "trajectories" in claim 33 does not address the direction of deflection.

C. The Lewis-Brown Patent

Upon hearing of Sweet's work in late 1962, Arling D. Brown and Arthur M. Lewis of Brush Instruments added a character or function generator to Sweet's droplet-printing device thereby enabling the device to print alphanumeric characters. Attached as Appendix B is one of the illustrative embodiments included in the Lewis-Brown patent. Character generators are devices which are able to "store" letters and numerals and to send to the charging electrodes voltage signals corresponding to the letters and numerals. Messages, consisting of a predetermined sequence of letters and numerals, are sent to the character generator which translates the message to a series of voltage signals and then relays the translated message to the charging electrodes which then charge the appropriate droplets to the appropriate level thereby causing the message to be printed.

The first Lewis-Brown application was filed on September

[6] See notes 3 and 4, *supra*.

25, 1964.[7] Two further applications were filed during 1965; both contained essentially the same disclosures as the initial application. After a brief prosecution, the Lewis-Brown patent issued on January 10, 1967, and A.B. Dick became the exclusive licensee under it.

After the Lewis-Brown patent issued, Sweet, whose application was pending, copied claims from the Lewis-Brown patent in order to provoke an interference proceeding between himself and Lewis and Brown. After a lengthy interference process, the Patent Office Board of Interferences resolved the question of priority of invention in favor of the Lewis-Brown patent, holding that the Sweet patent application did not disclose a character generator and therefore Sweet could not claim it in hindsight in combination with the droplet-printing apparatus which his application did disclose.[8]

D. The Sweet-Cumming Patent

In May, 1963, during the course of Sweet's work on the original Sweet device, Dr. Cumming, Sweet's supervisor, directed Sweet's attention to a recording system that used a dense array of wire styluses situated above and across a specially treated paper. Trial Transcript at 100. When electrical potential was applied to an individual stylus in the array, current passed from the stylus to the specially treated paper, which produced marks that combined to form the desired character.

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[7] In the brief prosecution of the Lewis-Brown patent application, the Patent Office examiner cited four prior-art references, including an earlier publication by Sweet describing his invention and the use of a sine-wave generator in conjunction with it. 521 F.Supp. at 176.

[8] In rendering its decision, the Board of Interferences adopted the position taken by Lewis and Brown on the limited scope of the Sweet patent application:

> Sweet's system records a cursive line representative of the voltage of an unknown, incoming waveform. A "picture" of the waveform appears on a moving strip of paper. . . . *It writes a continuous line, a cursive line,* the length depending upon the length of the incoming signal. (emphasis added)

Dr. Cumming realized that the wire styluses could be replaced with ink jets, such as those used in the original Sweet device, thereby dramatically improving the speed of the system.

After several brainstorming sessions, Sweet and Cumming proposed that Stanford's research laboratory develop this idea, but the research proposal was rejected. Undaunted, Sweet approached Honeywell with the idea, since Honeywell had helped Sweet in his initial patent application. On March 25, 1964, Honeywell, acting on behalf of Sweet and Cumming, filed a patent application that disclosed a device utilizing the multiple jet configuration. The original Sweet-Cumming application disclosed only a facsimile recorder, but an amendment was later filed that disclosed a character generator which enabled the Sweet-Cumming device to print characters. The Sweet-Cumming patent, No. 3,373,437, was issued on March 12, 1968. Attached as Appendix C is an illustration of the Sweet-Cumming invention.

The invention disclosed in the Sweet-Cumming patent is described in the patent as "an improvement over the recording system disclosed and claimed" in the Sweet patent. More specifically, the Sweet-Cumming device is described as "utilizing the principles" of the Sweet patent but being "particularly adapted for presenting a display image as distinguished from a line trace."

The record is silent as to why Sweet and Cumming elected to file an entirely separate patent application that expressly claimed the ability to print predetermined characters with ink droplets. The trial court did not expressly draw any inference from this fact, although it did note that the Sweet-Cumming patent acknowledges an indebtedness to Sweet's prior work. 521 F. Supp. at 177.

Neither Sweet nor Cumming ever actually built a machine based on the techniques and apparatus disclosed in the Sweet-Cumming patent. Shortly after the patent issued, Sweet assigned his interest to A.B. Dick while Cumming assigned his interest to Mead.

E. The DIJIT Printer

In 1967 Mead began in earnest a research and development effort which culminated in the Mead DIJIT printer, the accused device. Attached as Appendix D is an illustration of the DIJIT. While the DIJIT printer embodies virtually all of the principles and techniques disclosed in the Sweet-Cumming patent, Mead's research was independent of the research conducted by Sweet and Cumming.[9] Shortly after the Sweet-Cumming patent issued, Mead purchased Cumming's interest: the DIJIT can thus be thought of as an application of the Sweet-Cumming patent.[10]

The DIJIT printer contains a row of orifices situated above and across the recording medium so that the recording medium travels underneath the orifice array in a direction perpendicular to the array. A continuous stream or jet of ink issues from each orifice simultaneously and each jet is broken into evenly sized and spaced droplets by a process similar to that used in the Sweet and Lewis-Brown devices. Unlike the other devices, though, all of the droplets that print in the DIJIT are essentially undeflected: images are formed by deflecting into a collector or interceptor selected droplets from selected orifices and permitting the remaining droplets to fall undeflected onto the recording medium. Droplet interception is controlled by a computer which can be programmed to send instructions appropriate for printing alphanumeric characters as well as facsimile reproductions of video signals.

The process by which droplets are deflected in the DIJIT is similar to that used in the Sweet and Lewis-Brown devices: each droplet passes near a charging electrode and then through

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[9] The appearance of the Sweet-Cumming patent in 1968 created a state of shock in the Mead engineers; their reaction was "how can two organizations or two people completely independently in the same, almost precise time frame be pursuing the same area of investigation." Trial Transcript at 667.

[10] Appellants concede that the DIJIT printer is an application of the Sweet-Cumming patent. Appellants' Brief at 21.

a deflection field. The interaction of the charge placed on the droplet with the electrostatic field causes the droplet to change its course.

However, since the sole purpose of deflection in the DIJIT is to prevent selected droplets from reaching the recording medium, all deflected droplets receive a virtually identical charge. Thus, only two charge levels are necessary in the DIJIT: one charge level (one hundred volts) deflects the droplets to the catcher while the other charge level (zero volts) permits the droplets to travel undeflected to the recording medium. Deflection is used in the Sweet and Lewis-Brown devices to direct droplets to various locations on the recording medium as well as to direct droplets to a collector. To accomplish this result, multiple charge levels are used in those devices.

Moreover, deflection in the DIJIT is longitudinal with respect to the movement of the recording medium, that is, the ink droplets are deflected in the same direction that the recording medium travels. Longitudinal deflection is used since all deflected droplets are intended to be intercepted and the interceptor or collector is situated across the recording medium, parallel to the orifice array. As noted earlier, the District Court concluded that the Sweet device discloses only transverse deflection.

II. MEAD'S INFRINGEMENT OF THE SWEET PATENT

A. Applicable Legal Principles

The infringement issue in this case turns on the application of the "doctrine of equivalents," a canon of patent construction sometimes used in infringement cases to determine the scope of patent claims. This doctrine holds that a device is in infringement even if it does not "literally" infringe the patent "if it performs substantially the same function in substantially

the same way to obtain the same result." *Sanitary Refrigerator Co.* v. *Winters*, 280 U.S. 30, 42 (1929). However, as Justice Jackson noted in *Graver Mfg. Co.* v. *Linde Co.*, 339 U.S. 605, 608-609 (1950), the doctrine of equivalents is a two-edged sword: "where a device is so far changed in principle from a patented article that it performs the same or similar function in a substantially different way, but nevertheless falls within the literal words of the claim, the doctrine of equivalents may be used to restrict the claim and defeat the patentee's action for infringement." The doctrine thus may be applied in favor of as well as against a patentee. It can be used to hold a device in infringement even though the device does not literally infringe the patent claims; it can be used to hold a device not in infringement even though the device falls within the literal words of the claim.

The general purpose of the doctrine is to encourage patentable inventions as well as genuine improvements of existing inventions but to discourage what Justice Jackson in *Graver* calls "unimportant and insubstantial changes and substitutions in the patent which, though adding nothing, would be enough to take the copied matter outside the claim, and hence outside the reach of the law" in the absence of a flexible doctrine designed to protect the patentee from insubstantial changes. 339 U.S. at 607.

The doctrine "is not the prisoner of a formula," and "a finding of equivalents is a determination of fact. . . . It is to be decided by the trial court and that court's decision, under general principles of appellate review, should not be disturbed unless clearly erroneous." 339 U.S. at 609-10. Judge Hand referred to the doctrine as "in misericordiam to relieve those who have failed to express their complete meaning" in the patent and stated that its application in "each case is inevitably a matter of degree." *Claude Neon Lights, Inc.* v. *E. Machlett's Sons*, 36 F.2d 574, 576 (2d Cir. 1929). Many courts have said that a patent should be accorded a wider

range of equivalents if it represents a major step in the field such that it may be called a "pioneer patent." *See, e.g., Boyden Power-Brake Co.* v. *Westinghouse*, 170 U.S. 537, 569 (1898); *Acme Highway Product Corp.* v. *D.S. Brown Co.*, 473 F.2d 849 (6th Cir. 1973).

Appellants direct us to the following passage in *Graver* as controlling: "If accused matter falls clearly within the claim, infringement is made out and that is the end of it." 339 U.S. at 607. This so-called doctrine of "literal infringement" continues to live in the cases despite repeated pronouncements that infringement is not a mere matter of words. *See* CHISUM, *Patents* § 18.04[4] (1983) and cases cited therein. Indeed, in *Graver* the Supreme Court indicates that the doctrine of literal infringement is not to be taken literally: two paragraphs after announcing that doctrine the Court recognizes that the doctrine of equivalents applies even when the accused device "falls within the literal words of the claim." 339 U.S. at 608-09.

Courts, however unfortunately, continue to pay lip service to the doctrine of literal infringement as though it were the rule in *Shelley's Case*. Perhaps we are embarrassed to expose the "wholesale realism" which controls many infringement cases, *see* 339 U.S. at 608, and we choose instead to present the facade of precision and certainty which attends the doctrine of literal infringement.

As Judge Hand pointed out in *Claude Neon Lights*, there is no doubt that the doctrine of equivalents "violates in theory the underlying and necessary principle that the disclosure is open to the public save as the claim forbids, and that it is the claim and that alone which measures the monopoly." 36 F.2d at 575 (citations omitted). As Hand stated, the doctrine is an "anamoly" needed to soften and render flexible the rule of literal infringement.

The "wholesale realism" of the doctrine of equivalents means that precedents have "little or no value" since a decision is "bound to have an arbitrary color, as in all close cases

of interpretation, and it is difficult to give it greater authority than an appeal to the sympathetic understanding of an impartial reader." *Claude Neon Lights*, 36 F.2d at 576. This result will not set well with those who demand rules in this area and treat patent law problems as questions of semantics. Settled expectations are an important goal, but the survival of the doctrine of equivalents in this specialized field demonstrates that "unsparing logic" must be tempered with "wholesale realism." *See Royal Typewriter Co.* v. *Remington Rand, Inc.*, 168 F.2d 691, 692 (2d Cir. 1948).

With these general legal principles in mind, we now turn to the arguments advanced by appellants to support their assertion that the DIJIT printer infringes the Sweet patent.

B. Appellants' Infringement Arguments

Appellant's principal argument is that the District Court improperly circumscribed the Sweet patent by its illustrative embodiments: a patent is measured, appellants argue, by its claims and not its specifications or embodiments. Claims 1 and 33 of the Sweet patent, properly understood, extend far beyond oscillography, presumably to all ink jet printers that use the Sweet technique of selectively charging ink droplets. They argue that Sweet's invention consists of five elements – an ink jet generator, an ink jet stimulator, a droplet-charging mechanism, a deflecting mechanism, and a droplet-collection mechanism – and that the DIJIT printer contains and uses all five of these elements "in precisely the manner specified" in the Sweet patent. Appellant's Brief at 46. Appellants conclude therefore that the Sweet claims "read on" the DIJIT printer and that infringement follows as a matter of law.

Appellants are wrong on two counts. First, a finding of literal infringement is not the end of an infringement inquiry, despite numerous judicial statements to the contrary.[11] As

[11] *See* p. 14, *supra*.

this Court stated in *National Rolled Thread Die Co.* v. *E. W. Ferry Screw Products, Inc.*, 541 F.2d 593, 600 (6th Cir. 1976):

> Infringement should not be determined by a mere decision that the terms of a claim of a valid patent are applicable to the defendant's device. Two things are not necessarily similar in a practical sense because the same words are applicable to each. . . .
>
> There is no magic in a name, nor in a claim; that the words preferred by a patentee to define his invention apply literally to another's device suggests, but does not prove, infringement; there must be a substantial identity, to justify that conclusion of law.
>
> (citations omitted).

Put differently, the doctrine of literal infringement is informed by the doctrine of equivalents: in infringement actions the court must consider the substance of the invention along with the form of the claims. Thus, even were we to determine that the DIJIT printer "reads on" claims 1 and 33 of the Sweet patent,[12] we would still be required to consider whether those claims should be restricted by the doctrine of equivalents.

When we make this inquiry, we see that appellants mischaracterize the relation between the DIJIT printer and the Sweet patent: The DIJIT printer does not use the elements disclosed in the Sweet patent in "precisely the manner" specified in the patent. Rather, the DIJIT printer – to use the time-worn and conclusory formulation of the doctrine of equivalents – uses the elements disclosed in the Sweet patent in a substantially different way to achieve a substantially different result.

The Sweet patent does not contemplate a high speed character printer with coordinated multiple jets and a deflection system whereby all charged droplets are deflected into a col-

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[12] Since we determine that the DIJIT printer is not the equivalent of the invention disclosed in the Sweet patent, we need not consider whether it is in literal infringement.

lector and uncharged droplets are deposited on the recording medium to form the desired characters. The DIJIT printer, quite simply, is a more sophisticated device, embodying inventive insights not part of the Sweet patent. While it does rely on Sweet's fundamental concept of ink jet charging and deflection, it also incorporates those concepts of the Sweet-Cumming patent which Sweet himself described in that later patent as improvements over his original device. Those concepts include the coordination of multiple jets, interception for creating an apparent discontinuity in the image, and a charging and deflection system whereby the final picture is not characteristic of the charging signals.

The District Court thus correctly concluded that the Sweet claims must be restricted so as not to "read on" the DIJIT printer. This interpretation of the claims results from the application of the doctrine of equivalents, not from a mistaken reliance on the illustrative embodiments of the patent, as appellants believe.

In reaching this conclusion, we are heavily influenced by the fact that after his initial research, Sweet joined with Cumming to file and obtain a second patent disclosing, in essence, the Mead DIJIT printer. The fact that Sweet filed for a new patent with Cumming represents a contemporaneous implied admission that the Sweet-Cumming complex system of charging an array of jets and using uncharged droplets for writing constitutes a significant advance on Sweet's original work. This is the only reasonable explanation for Sweet's conduct. Appellants cannot deny that a pioneer in the field – Sweet himself – clearly appears to have believed in the early 1960s that the Sweet-Cumming patent – and thus the DIJIT printer – was a significant advance and should be independently patented. Actions sometimes testify more truly about a man's purpose than his words. We are more persuaded by Sweet's conduct at invention time than by his testimony at trial when his interests may have changed because of the way he had sold his patent rights.

Although the Sweet-Cumming patent may not represent the basic advance, the quantum leap in insight, represented by the Sweet patent, it is a useful improvement not self-evident from Sweet's first discovery. Sweet should not be relieved of his failure to express this separate advance in his original patent by Judge Hand's "misericordiam." The two insights, separately patented, should not be conflated into one, although the first was the more pioneering effort.

III. THE VALIDITY OF THE LEWIS-BROWN PATENT

The District Court held the Lewis-Brown patent invalid under 35 U.S.C. § 103[13] on the grounds that in light of the prior art the subject matter of the patent taken as a whole would have been obvious to a person of ordinary skill in the art at the time the invention was conceived. 521 F. Supp. at 185. Appellants argue that in reaching this conclusion the District Court disregarded the presumption created by 35 U.S.C. § 282[14] that a patent is valid over the prior art considered by the Patent Office. Since the District Court considered the same prior art as did the Patent Office, appellants

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[13] 35 U.S.C. § 103 provides that

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

[14] 35 U.S.C. § 282 provides in pertinent part that:

> A patent shall be presumed valid. Each claim of a patent (whether in independent, dependent, or multiple dependent form) shall be presumed valid independently of the validity of other claims; dependent or multiple dependent claims shall be presumed valid even though dependent upon an invalid claim. The burden of establishing invalidity of a patent or any claim thereof shall rest on the party asserting such invalidity.

argue that the District Court was bound by the Patent Office's determination of validity.

Appellants misapprehend the nature of the presumption created by 35 U.S.C. § 282.[15] As this Court noted in *Universal Electric Co.* v. *A.O. Smith Corp.*, 643 F.2d 1240, 1245 (6th Cir. 1981), the presumption merely places the burden of proof of invalidity on the party raising the issue and it has no independent evidentiary value. It does not prevent a court "save in cases of clearest error" from invalidating a patent on the prior art the Patent Office considered, as appellants would have us hold.

In *Graham* v. *John Deer Co.*, 383 U.S. 1, 17 (1966), the Supreme Court established the factual inquiries that must be made when obviousness is alleged: "the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved." Once these factual determinations are made, the court must then decide as a matter of law whether the subject matter of the patent in issue is obvious. The findings of the District Court on the factual issues are subject to the clearly erroneous standard. *Universal Electric*, 643 F.2d at 1247 and cases cited therein.

Regarding the scope and content of the prior art, the District Court found that the use of character generators in connection with ink drop printing was known in the art prior to Lewis' and Brown's work: the Winston patent discloses a character generator of sorts and Sweet used a sine-wave generator, a kind of function generator, with his machine. 521 F. Supp. at 183.

Regarding the differences between the prior art and the claims at issue, the District Court found that the Lewis-Brown

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[15] We note that if appellants' view of this statute controlled, their infringement argument as to the Sweet patent falls, since the DIJIT printer is based on the Sweet-Cumming patent, which the Patent Office validated over the Sweet patent.

patent discloses, in essence, a function generator like that used in the Winston device attached to an ink droplet charging apparatus like that used in the Sweet device. 521 F. Supp. at 176.

Regarding the level of ordinary skill in the pertinent art at the time of Lewis' and Brown's work, the District Court found that artisans in the field of ink jet printing were familiar with the use of character generators. 521 F. Supp. at 183. The court also cited the short time that passed between Sweet's invention and the Lewis-Brown invention as evidence that the use of a character generator with the Sweet device would have been obvious to a person of ordinary skill in the art. *Id.*

Based on our review of the record, we cannot say that any of these findings are erroneous. A consideration of these findings leads to but one conclusion: attaching a character generator to the Sweet device — which appellants concede is the Lewis-Brown "invention", Appellant's Brief at 19, — would have been obvious to a person of ordinary skill in the art at the time of Lewis' and Brown's work.

Since we agree with the District Court that the Lewis-Brown patent is invalid for obviousness, we need not consider the District Court's conclusion that the DIJIT printer does not infringe this patent.[14] *Universal Electric*, 643 F.2d at 1241.

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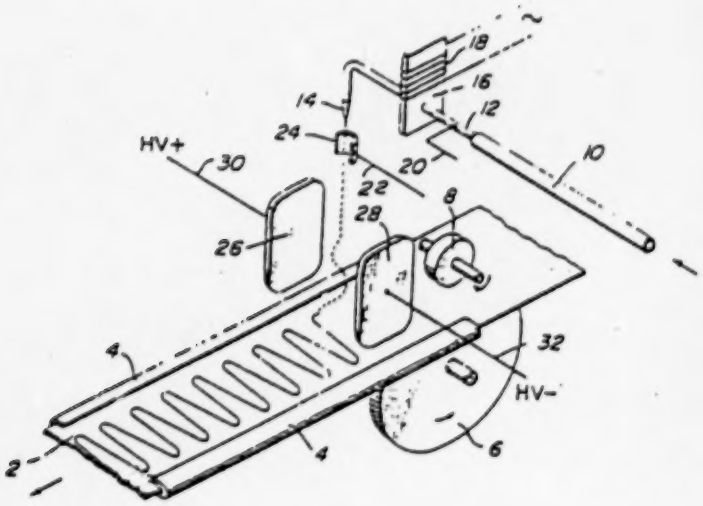
[14] The District Court also held the Lewis-Brown patent invalid under 35 U.S.C. § 102(f) to the extent that it claims invention of the use of a sine-wave generator in connection with the operation of Sweet's invention because Sweet, not Lewis and Brown, invented the subject matter so described. 521 F. Supp. at 185. 35 U.S.C. § 102(f) provides that a person shall be entitled to a patent unless "he did not himself invent the subject matter sought to be patented." While we need not review this determination given our decision that the patent in its entirety is invalid, we note that the District Court's decision on this issue was clearly correct.

Appellants characterize claim 2 of the Lewis-Brown patent as "explicitly drawn to a character printer." Appellants' Brief at 49. However, the patent defines the word "character" to include waveforms. 521 F. Supp. at 176. Claim 2 thus discloses in part an apparatus

Accordingly, the judgment of the District Court is affirmed.

"responsive to input signals characteristic of predetermined [waveforms] for printing said predetermined [waveforms] on a recording medium;" in other words, an ink jet oscillograph. To the extent that claim 2 discloses an ink jet oscillograph, it is clearly invalid under § 102(f), since no one disputes that Sweet first invented such an apparatus.

APPENDIX "A"

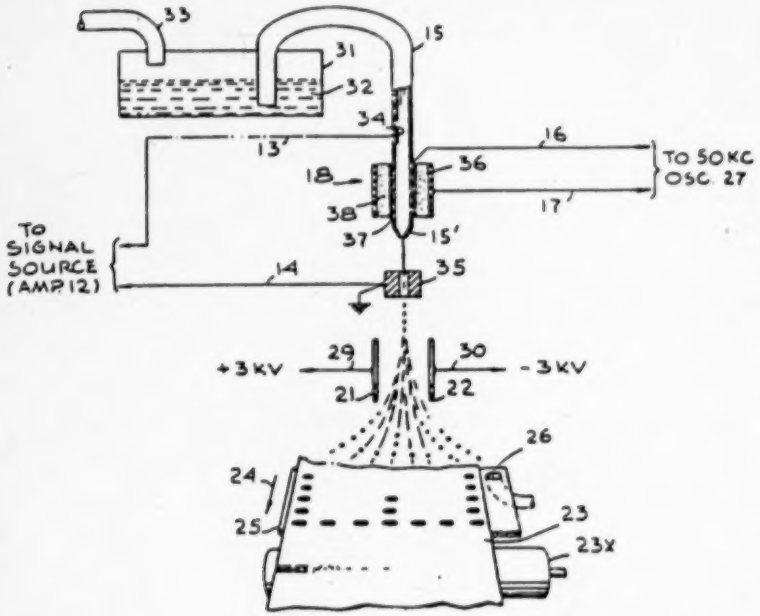


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APPENDIX "B"

Jan. 10, 1967 A. M. LEWIS ET AL 3,298,030

ELECTRICALLY OPERATED CHARACTER PRINTER

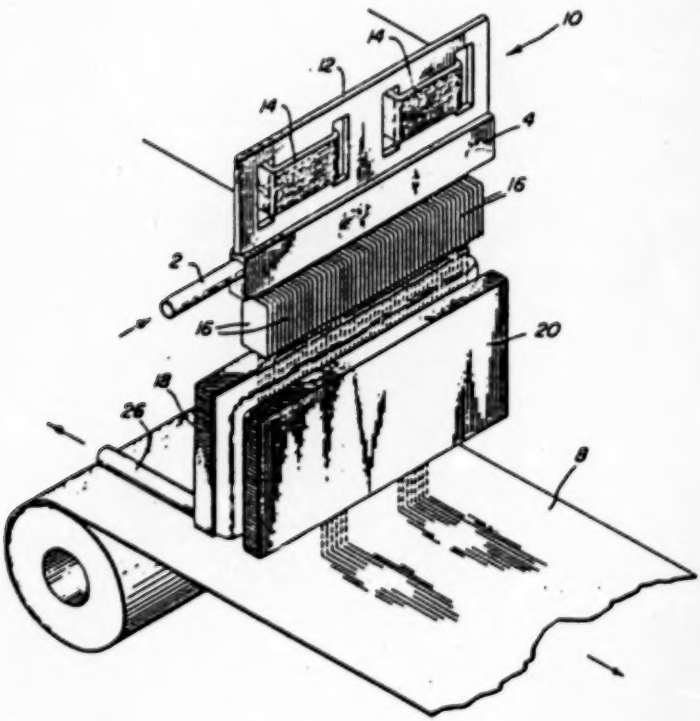


24 *Mead Corp., et al.* v. *A.B. Dick, et al.* Nos. 82-3163, -3178

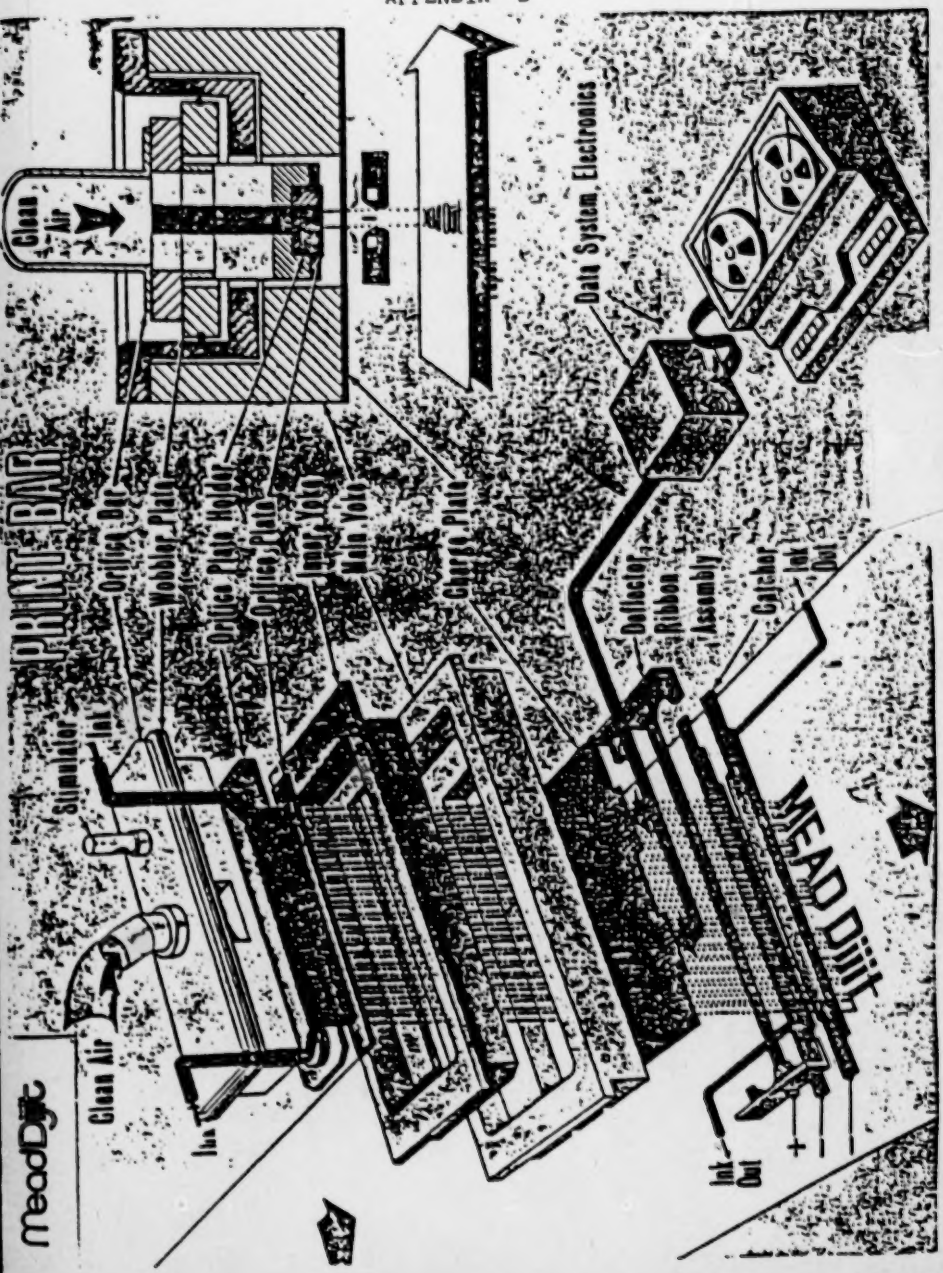
APPENDIX "C"

March 12, 1968 R. G. SWEET ET AL 3,373,437

FLUID DROPLET RECORDER WITH A PLURALITY OF JETS



APPENDIX "D"


Clean Air
Ink Out
Data System Electronics
PRINT BAR
Stimulator
Ink
Orifice Bar
Wobbler Plate
Orifice Plate Holder
Orifice Plate
Ink
Clean Air
Ink
Main Yoke
Charge Plate
Deflector
Ribbon
Assembly
Catcher
Ink Out
MEAD Digit
Ink Out
+
MeadDigit